MASSACHUSETTS MILITARY RESERVATION

Impact Area Groundwater Study Action Plan

Pollution Prevention Plan

Public Involvement Plan

Prepared by the
National Guard Bureau
in coordination with the
U.S. Environmental Protection Agency

14 March 97

DEPARTMENTS OF THE ARMY AND THE AIR FORCE
NATIONAL GUARD BUREAU
111 SOUTH GEORGE MASON DRIVE
ARLINGTON, VA 22204-1382
March 14, 1997

Installations, Logistics and Environment
Directorate

Ms. Jane Dolan
Environmental Protection Agency (EPA)
Office of Site Remediation and Restoration
U.S. Federal Building (HBT)
Boston, Massachusetts 02203-0001

Dear Ms. Dolan:

Pursuant to the requirements of the Administrative Order issued by your office February 27, 1997 this letter serves as official notification for four (4) actions to be completed on March 14, 1997. These actions are as follows:

a. Scope of Work, Section II, paragraph A. Provide EPA & public all information in its possession on known or potential contaminants in soil and groundwater on, near and emanating from the training range and impact area of the Massachusetts Military Reservation (MMR). An extensive literature search of the Massachusetts Army National Guard and Installation Restoration Program files has been completed and copied. As requested, three sets are being provided to the EPA Regional Office, one set to the Massachusetts Executive Office of Environmental Affairs and one set to each of the community libraries in Bourne, Falmouth, Mashpee, Sandwich and the Coast Guard Post library for public review.

b. Scope of Work, Section II, paragraph B. Provide EPA Technical Project Coordinator & public an accelerated schedule and work plan with specific dates for conducting and completing an independent, comprehensive study of the effects on public health and the environment of past, present , and future activities on or near the training range and impact area. A revised impact area groundwater study plan to include schedules and timelines is provided. Comments received during the draft action plan review by the EPA, Massachusetts Department of Environmental Protection, Installation Restoration Program, and Long Range Water Supply Process Action Team have been incorporated. Based on the discussions with the EPA staff on 7 March, it is our understanding that this document will be subject to change.

Printed on Recycled Paper

c. Scope of Work, Section IV. Provide EPA a plan for ensuring adequate public involvement in all work undertaken pursuant to the Administrative Order and Scope of Work. A comprehensive public involvement plan is provided.

d. Scope of Work, Section II, paragaph B.6. Provide EPA a pollution prevention plan acceptable to the EPA. A pollution prevention plan covering the actions and activities surrounding the central impact area of the MMR which includes the buffer zone and small arms ranges is provided. On March 12, 1997 your legal counsel made an oral request for MMR's training schedule, to be included with this submission. Although we question whether this request is within the scope of the Administrative Order, we note that the ranges to be placed in mobilization status are listed in the pollution prevention plan that is part of this submittal. How the training schedule will be impacted by placing these ranges in mobilization status has yet to be determined.

Should you or your staff need additional information or clarification on these actions, please contact Mr. Winters at 703-607-7860.

Sincerely,

William R. Crocker
Colonel, U.S. Army
Deputy Director of Army National Guard, Installations, Logistics, and Environment

Copies Furnished:

Massachusetts Executive Office of Environmental Affairs
Bourne Public Library
Falmouth Public Library
Mashphee Public Library
Sandwich Public Library
Coast Guard Post Library

Work Plan for the Massachusetts Military Reservation Training Range and Impact Area Response Action

pursuant to EPA Region I Administrative Order SDWA I-97-1019

TABLE OF CONTENTS

Tab A - Draft Action Plan for the Camp Edwards Impact Area Groundwater Quality Study

This action plan contains the following as required by the Administrative Order:

- Description of soil sampling to be performed at and near the Training Range and Impact Area.
- Description of groundwater sampling to be performed at and near the Training Range and Impact Area.
- Description of stormwater sampling to be performed at and near the Training Range and Impact Area.
- Description of surface water sampling to be performed at and near the Training Range and Impact Area.
- Description of the health and safety measures to be undertaken in the performance of the work required.

Tab B - The Training Range and Impact Area Pollution Prevention Plan

This plan contains the following as required by the Administrative Order:

- Description of pollution prevention measures to be undertake to mitigate the possible effects on public health and the environment from any current and/or future activities at the Training Range and Impact Area.

Tab C - The Public Involvement Plan

This plan, required by the Administrative Order, describes how the Army National Guard will:

- Make immediately available to the public all nonprivileged information obtained or compiled pursuant to EPA Region 1 Administrative Order SDWA I-97-1019.
- Coordinating the work under the Order and SOW with the citizens advisory committee which will be established by EPA.
- Providing periodic oral and written updates to the public on the progress of the work.
- Sharing immediately with the public all conclusions reached with respect to the effects of past and present activities at the Training Range and Impact Area.
- Coordinating the work under this Order and SOW with response actions being undertaken at MMR by the Installation Restoration Program.

MASSACHUSETTS MILITARY RESERVATION

IMPACT AREA GROUNDWATER STUDY ACTION PLAN

14 March 1997

DRAFT

ACTION PLAN FOR THE CAMP EDWARDS IMPACT AREA GROUNDWATER QUALITY STUDY

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

Prepared for

NATIONAL GUARD BUREAU
ARLINGTON, VIRGINIA

and

THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, REGION I
pursuant to EPA Region I Administrative Order SDWA I-97-1019

Prepared by

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
3458 Ellicott Center Drive, Suite 101
Ellicott City, Maryland

March 1997

Table of Contents

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Overview 3
1.3 Objectives of the Investigation 5
1.4 Environmental Concerns at the Training Range and Impact area 6
1.5 Scope of the Action Plan 9

2.0 BACKGROUND AND ENVIRONMENTAL SETTING 10
2.1 Site Location and History 10
2.2 Site Description 10
2.2.1 Physiography and Surface Waters 13
2.2.2 Geology 15
2.2.3 Hydrogeology 15
2.3 Previous Investigations 18
2.4 Environmental Fate and Transport 22
2.4.1 Explosive Compounds 22
2.4.1.1 TNT 23
2.4.1.2 RDX and HMX 23
2.4.1.3 Other Explosive Compounds 24
2.4.2 Metals 25

3.0 TASK EVALUATION AND SCOPE 26
3.1 Investigation 30
3.1.1 Archives Search 31
3.1.2 Review of Aerial Photographs 31
3.1.3 Unexploded Ordnance Survey 31
3.1.4 Surface Water, Soil and Sediments Sampling 32
3.1.4.1 Surface Water and Sediments Sampling 32
3.1.4.2 Soil Sampling 32
3.1.4.3 Groundwater Sampling 33
3.1.4.4 Stormwater Sampling 35
3.1.5 Investigation Well Installation 35
3.1.6 Elevation and Location Survey of Investigation wells 37
3.1.7 Well Site Clean-up and Restoration 38
3.1.8 Water Level Measurements 38
3.1.9 Aquifer Testing 38
3.2 Preliminary Risk Evaluation 39
3.3 Follow-on Actions 39
3.3.1 Risk Assessments 40
3.3.2 Response Plans 40
3.3.3 Installation Response Program (IRP) Investigation Referral 40
3.3.4 Long Term Monitoring Program 41

4.0 SAMPLING AND ANALYSIS 42
4.1 Sampling Program 42
4.1.1 Field Screening 42

4.1.2 Well Installation 42
4.1.4 Surface Water/Sediment Sampling 45
4.1.4 Soil Sampling 45
4.1.5 Water Level Measurements 47
4.1.6 Groundwater Sampling 47
4.1.7 Sample Designations and Identification 48
4.1.8 Waste Handling 49
4.1.9 Health and Safety Monitoring 49
4.1.10 Hydrogeologic Characterization 50
4.1.11 Quality Control Samples 50
4.1.11.1 Field and Trip Blanks 50
4.1.11.2 Equipment Rinsates 51
4.1.11.3 Field Duplicates 51
4.1.11.4 Matrix Spike/Matrix Duplicate samples 51
4.2 Analytical Program 51
4.2.1 Field Screening 52
4.2.2 Laboratory Analysis 52
4.2.3 Data Management and Evaluation 53
4.2.4 Well Head Protection Area Review 53

5.0 DECONTAMINATION AND WASTE DISPOSAL 55
5.1 Decontamination 55
5.2 Waste Disposal 56
5.2.1 Personal Protective Equipment (PPE) 56
5.2.2 Soil 57
5.2.3 Water 57

6.0 SITE-SPECIFIC QUALITY CONTROL AND HEALTH AND SAFETY PLAN 59
6.1 Quality Assurance Project Plan 59
6.2 Health and Safety Plan 59

7.0 PROJECT MANAGEMENT AND SCHEDULE 61
7.1 Project Management 61
7.1.1 Organizational Structure 61
7.1.2 Subcontractors 64
7.2 Schedule 64
7.2.1 Overall Project Schedule 64
7.2.1 Deliverables 64

8.0 RECORD KEEPING AND REPORTING 66
8.1 Record Keeping 66
8.2 Reporting 68

9.0 REFERENCES 71

List of Figures

Figure 1-1	Site Location Map	4
Figure 2-1	Training range and impact area	11
Figure 2-2	Gun and Mortar Positions, Ranges, and Impact Area	12
Figure 2-3	Physiographic Map of the Training Range and Impact Area	14
Figure 2-4	Area Geology	16
Figure 2-5	Groundwater Elevation Contours	17
Figure 2-6	Areas of Interest based on Aerial Photographs	20
Figure 3-1	Proposed Monitoring Wells Location Map	28
Figure 3-2	Soil, Surface Water, and Sediment Sampling Locations	29
Figure 3-3	Typical Soil Sampling Grid	34
Figure 4-1	Zone II Wellhead Protection Areas	54
Figure 7-1	Organizational Chart	62
Figure 7-2	Proposed Schedule	65

List of Tables

Table 4-1 Sample Types, Numbers and Analytes 43

List of Acronyms and Abbreviations

ABB	ABB Environmental Services, Inc.
AFCEE	Air Force Center for Environmental Excellence
ANG	Air National Guard
AOC	Area of Concern
APC	Armored Personnel Carrier
APR	Air Purifying Respirator
ARAR	Applicable, Relevant, and Appropriate Requirements
ARNG	Army National Guard
CDM	Camp Dresser and McKee
CLP	Contract Laboratory Procedure
CS	Chemical Spill
DO	Dissolved Oxygen
DNT	Dinitrotoluene
EMT	Emergency Medical Technician
EPA	Environmental Protection Agency
ERI	Environmental Research, Inc.
FID	Flame Ionization Detector
GP	Gun Position
HASP	Health and Safety Plan
HE	High explosive
HMX	Cyclotetramethylenetetranitramine
IDW	Investigation Derived Waste
IRP	Installation Restoration Program
kg	Kilogram
LITR	Light inexpensive training round
LRWSPAT	Long Range Water Supply Process Action Team
MAARNG	Massachusetts Army National Guard
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
mg	Milligram
MMR	Massachusetts Military Reservation
MSL	Mean Sea Level
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NAD27	North American Datum 1927
NGVD	National Geodetic Vertical Datum
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PID	Photoionization Detector
PPB	Parts Per Billion
PPE	Personal Protective Equipment
PPM	Parts Per Million
PRE	Preliminary Risk Evaluation
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
RAH	Risk Assessment Handbook

RDX	Cyclonite
SA	Site Assessment
SOP	Standard Operating Procedures
SVOC	Semi-Volatile Organic Compounds
TAL	Target Analyte List
TCL	Target Compound List
TNT	Trinitrotoluene
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USAEHA	United States Army Environmental Hygiene Agency
USGS	United States Geologic Survey
UXO	Unexploded Ordnance
VA	Veterans Administration
VOC	Volatile Organic Compound
WHPA	Well Head Protection Area

1.0 INTRODUCTION

The Army National Guard fully intends to partner with the Environmental Protection Agency (EPA) and other federal agencies to ensure a thorough, scientifically sound investigation of the effects of military operations on the groundwater beneath the impact area. By working with the EPA, the Massachusetts Department of Environmental Protection (MADEP), local officials and the citizens of Cape Cod, the Army National Guard (ARNG) pledges to complete the investigation and take the necessary steps to protect the environment of Cape Cod while providing realistic training for our citizen soldiers.

1.1 Background

In July 1996 the National Guard Bureau (NGB) and the Massachusetts Army National Guard (MAARNG) were directed by the Deputy Undersecretary of Defense for Environmental Security [DUSD(ES)] to study the effects of military operations on the groundwater beneath the impact area. This study was in response to concerns raised by EPA Region I in a letter to DUSD(ES).

In August 1996 NGB assembled experts from the Army, the Air Force, the Massachusetts Army National Guard, the Army Corps of Engineers, the Army Environmental Policy Institute, Air Force Center for Environmental Excellence, Army Environmental Center, the Army Center for Health Promotion and Preventative Medicine and Georgia Institute of Technology to create an action plan to complete the study. Engineering Technologies Associates, Inc. was retained to write the action plan in accordance with the guidance provided by the working group.

In October 1996 the MAARNG began working with the Long Range Water Supply Process Action Team (LRWSPAT) on the development of the action plan. Numerous briefings were presented while the action plan was developed.

In December 1996 a rough draft of the action plan was presented to the EPA, MADEP, and members of the LRWSPAT, which includes the EPA, MADEP, the Cape Cod Commission (CCC), and the water districts of Bourne, Falmouth, Mashpee, and Sandwich. The goal of this comment period was to solicit their input in the further development of the action plan. NGB requested comments be returned by 15 January 1997 so a final draft could be released for public review in March or April.

In February 1997 the action plan was drastically changed to address the comments received from the EPA, MADEP, and other members of the LRWSPAT and a Response to Comments was written. On February 19, NGB and MAARNG arranged for explosives experts to brief the LRWSPAT. After this meeting, NGB and MAARNG met with EPA and MADEP. NGB and MAARNG agreed to complete and release the Response to Comments and a comment resolution workshop was scheduled for March 17, 1997. After the workshop the final draft plan would be released for public comment.

On February 27, 1997 EPA Region I released an Administrative Order directing the NGB to prepare a work plan for a comprehensive investigation of the groundwater beneath the impact area. The Administrative Order provides for complete EPA oversight and participation and establishes a citizens advisory committee to monitor the work.

On March 3, 1997 the Chief of National Guard Bureau met with EPA Region I and pledged the NGB's full cooperation and support. On March 7, 1997 NGB presented the concept of the action plan to the EPA, MADEP, and other members of the LRWSPAT and discussed comments received from the EPA, MADEP and the Cape Cod Commission. This discussion, along with the Administrative Order, guided the final development of this action plan, released to EPA, MADEP and the public on March 14, 1997.

1.2 Overview

The Massachusetts Military Reservation (MMR) is a 21,000 acre facility located in western Cape Cod in the towns of Bourne, Falmouth, Mashpee and Sandwich in Barnstable County (Figure 1-1). The facility is organized into four functional areas:

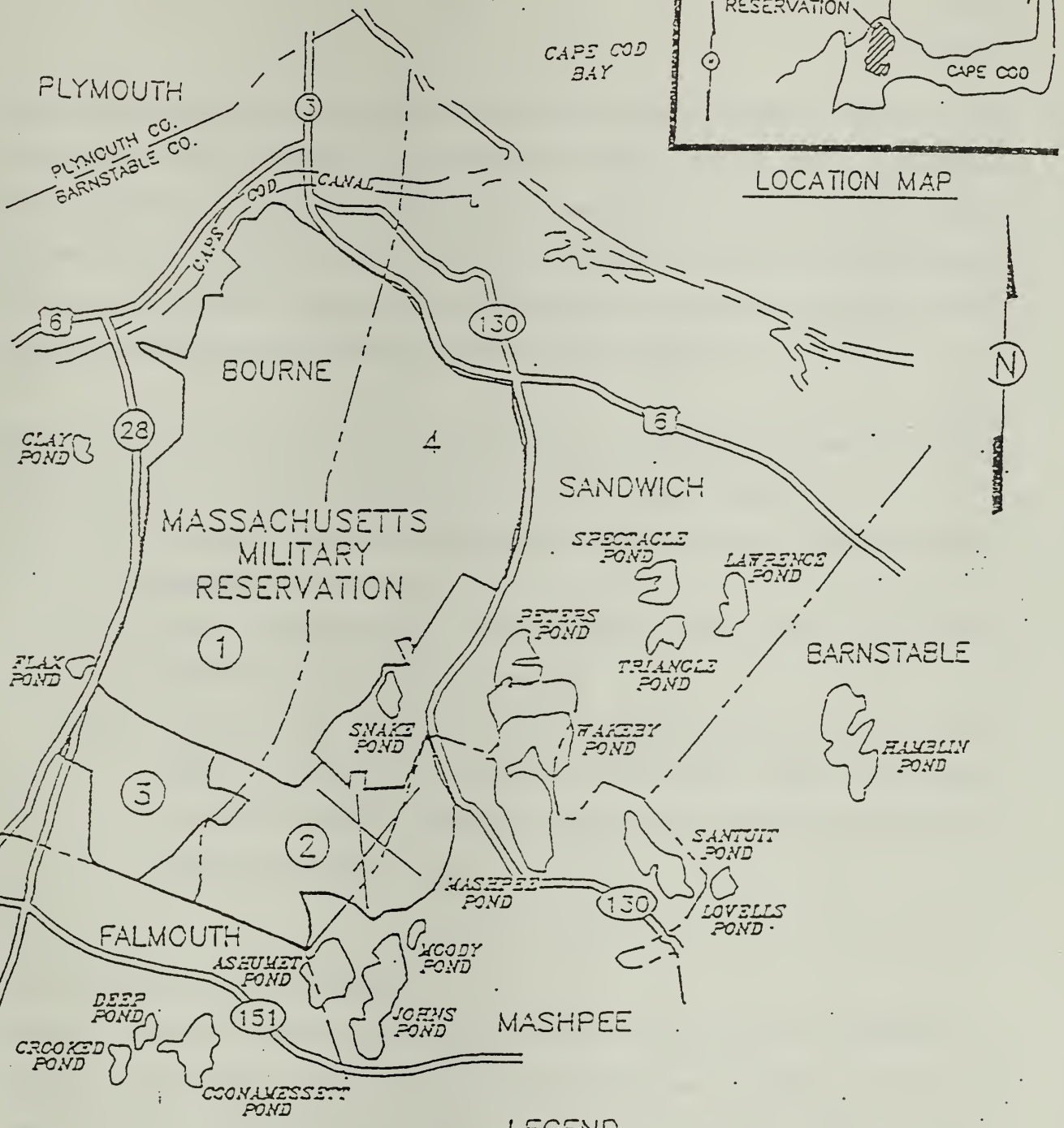
(i) The Cantonment Area: The most actively used section, it consists of the base administrative, housing, maintenance and operation facilities (Area 2 on Figure 1-1);

(ii) The Training Range and Impact Area: [MG2] Occupies most of the northern portion of the base, and is used for military training, law enforcement training and sport shooting (Area 1 on Figure 1-1);

(iii) The Veterans National Cemetery: Located in the southwestern corner of MMR, it contains a Veterans Administration (VA) Cemetery and support facilities (Area 3 on Figure 1-1), and

(iv) Cape Cod Air Force Station: Occupies the northeastern portion of the range area, and houses the air defense warning system (Area 4 on Figure 1-1).

Military use of MMR dates back to 1911, with the most intensive use of the facility occurring during and immediately after World War II. Most activities have been phased out to the current level consisting of the Otis Air National Guard Base airfield and military support facilities like the Veterans National Cemetery and the training range and impact area.



rce: Aneptek, 1995

DESIGNED ____ DATE	ENGINEERING TECHNOLOGIES ASSOCIATES, INC.	MMR IMPACT AREA WORKPLAN
DRAWN ____ DATE	ENGINEERS • PLANNERS • SURVEYORS	FIGURE 1-1
CHECKED ____ DATE	3456 ELLICOTT CENTER DRIVE SUITE 101 ELLICOTT CITY, MARYLAND 21043	MMR LOCATION MAP
APPROVED ____ DATE		SCALE: NTS | CONTRACT NO.: 92207.012 | DATE: 10/96 | SHEET:

The training range and impact area has been used for Army National Guard, law enforcement and fire protection training. Currently, the groundwater underneath the northern portion of MMR is being considered for development as potable water supplies for the four upper Cape towns of Bourne, Falmouth, Mashpee, and Sandwich. This action plan provides guidance and procedures for conducting fieldwork to gather data and information to determine the effects of military operations on the groundwater beneath the training range and impact area.

For more than 40 years, military and law enforcement training has been conducted in the training range and impact area at MMR. This training involves three distinct activities:

(i) Small arms firing at several ranges inside the study area, involving the use of small caliber munitions;

(ii) Artillery firing from gun and mortar locations into the impact area which is located in the center of the study area; and

(iii) Demolition ranges, one located to the north and just outside the study area; and another to the south of the impact area, located within a range inside the study area. The two demolition ranges are used to practice detonation procedures for explosives (see Figure 1-1).

1.3 Objectives of the Investigation

Working cooperatively with federal and state environmental agencies, the local authorities, the Long Range Water Supply Process Action Team (LRWSPAT), and the public on the Cape, the Army National Guard (ARNG) is conducting a study of the ground water quality beneath the training range and impact area at MMR. This study will determine whether the activities at the training range and impact area have affected, or will affect groundwater quality.

The study will include: a thorough review of the archives to investigate the types and volume of munitions used at MMR and determine the location of potential sources of contamination; the collection of data and information to verify the groundwater flow pattern in the training range and impact area; a preliminary investigation of suspected potential sources of contamination; human health and ecological risk assessments; and evaluation of the quality of groundwater beneath the study area. After a review of the data and as information becomes available, the scope of the investigation will be revised to include and adjust the number and location of investigation wells, conduct potential source investigations and aquifer characterizations to determine the long term effects of military operations on groundwater. The results of these investigations will be used to develop a long term monitoring program and the scope of the policy and/or technical response necessary to protect the quality of groundwater for the long term needs of the population on the Cape.

1.4 Environmental Concerns at the Training Range and Impact area

For more than 40 years, the training range and impact area at MMR has been used for military and law enforcement training. These training activities have been widely varied, as well as the size and types of munitions used. The impact of these activities and the fate of the spent munitions in the environment has been of interest for many parties on the Cape. The training and munitions used by activity and location are as follows:

(a) Small Arms Firing Ranges: These are outdoor pistol and rifle training ranges typically consisting of a firing position, a cleared range area, a target position, and an impact berm. Typically, the weapons that have been fired in these ranges are small caliber weapons including 50 caliber or smaller munitions; with the dominant choice being 5.56, 7.62 and 9 millimeter(mm) small arms rounds. The

primary constituent of these munitions is a lead core in a metal alloy jacket, usually composed of copper, iron , antimony and nickel.

(b) Artillery and Mortar Positions: These are small sites in the range area where the artillery and mortars are placed and fired at targets in the impact area. In the past, the spent shell casings and propellant bags were disposed of at these locations and/or in the vicinity of the artillery and mortar locations. The munitions used at these sites include 105 mm, 155 mm and 8 inch caliber artillery projectiles and 60 mm, 81 mm, and 4.2 inch mortar cartridges. The chemical constituents of these munitions are similar to those used at small arms ranges but also include explosive compounds.

(c) The Impact Area: This is the centrally located area in the range that contains the targets used for artillery and mortar firing. When the rounds fired are detonated, the explosive materials are generally consumed at the time of detonation. Sunlight degrades most of the remaining explosives. The metal shell casing breaks up into small pieces.

(d) Demolition Areas: These two locations are ranges that are used to practice detonation procedures for explosives. The environmental impacts associated with these ranges may be similar to the target areas in the impact area.

Explosives are defined as materials which have the potential to chemically change from a solid to a large volume of hot gases very quickly. High explosives (HE) are materials which undergo the chemical change at a rate faster than the speed of sound, such as: TNT (trinitrotoluene), RDX (Cyclonite) , mercury fulminate, and lead azide. Low explosives undergo a chemical change at a slower than the speed of sound and include black powder, smokeless powder and other propellants. TNT has been the most widely used military explosive since World War I. RDX

was developed during World War II, and is used in combination with TNT. Mercury fulminate and lead azide are used as primers in ammunition and are unstable.

The primary environmental interests associated with the historic, current and future use of the training range and impact area involve the metal projectiles from fired or "spent" munitions. The propellant is almost completely destroyed during firing, and while some propellant residues may accumulate at the firing point, the propellant itself is not likely to appear in the impact area. In the case of artillery firing, the excess propellant was burned after the firing, also in the immediate vicinity of the firing point. Artillery propellant bags are no longer burned at Camp Edwards. Currently, HE rounds are only used during mortar training. The HE mortar rounds are composed of Composition B explosives, which are a combination of TNT and RDX. The projectile body is composed of forged steel. Most of the explosives in a HE projectile are destroyed at impact. For sometime now, only metal projectiles, not the live HE artillery rounds have been fired into the impact area at MMR for artillery training. Low cost indirect training rounds (LITR) are used in place of HE rounds for artillery training. The LITR rounds are manufactured with a combination of metals (Zinc, Potassium, and Aluminum). There are no explosives used in the artillery projectiles.

The HE in the current munitions used are designed to be completely consumed during firing and upon impact. Therefore, only the metal projectiles end up in the impact area. These metals are not very mobile, and numerous studies have shown that they are contained in the first six inches to two feet of the soils.

The investigation will include additional screening analysis to help determine if other military activities in the study area may have effected the quality of groundwater.

1.5 Scope of the Action Plan

This action plan presents the technical and investigative aspects of the proposed study of groundwater quality beneath the training ranges and impact area at MMR as required by the administrative order.

The data gathered from this investigation will be used to modify the Pollution Prevention Plan also required by the Administrative Order. The Pollution Prevention Plan will determine the techniques and technologies available to prevent contamination resulting from military training activities.

2.0 BACKGROUND AND ENVIRONMENTAL SETTING

2.1 Site Location and History

The MMR is located on upper Cape Cod, approximately 60 miles southeast of Boston, Massachusetts (See Figure 1-1). The MMR consists of approximately 21,000 acres. Approximately 14,000 acres, occupying the northern seventy percent of MMR, constitutes the training range and impact area (Figure 2-1). The primary focus of this investigation is the impact area. A secondary focus is the small arms ranges, demolition ranges, artillery and mortar firing positions surrounding the impact area, and the Rod and Gun Club to the southwest of the study area (Figure 2-2).

For over 40 years, MMR has been used for military and law enforcement training. This training has included the firing of small arms, guns, hand grenades, artillery, mortar and ordnance demolition. The environmental interests associated with these activities could potentially affect groundwater.

2.2 Site Description

The training range and impact area is in the central portion of MMR. Numerous firing ranges, artillery and mortar positions, and training areas surround an impact area in the center of the study area (See Figure 2-2).

The impact area contains targets at which artillery and mortars are fired during training activities. The primary target area is the strip along the road in the southeast and central portions of the impact area referred to as "tank alley." (Tank alley is a row of metal tank hulls used as targets.) The northern portion of the impact area around the intersection of Woods, Turpentine and Sandwich roads (also known as the "five corners" area) used to be, but is no longer a target area. The impact area includes a 500 meter buffer zone around the target areas (See Figure 2-2).

DESIGNED	AJH	2/97 DATE
DRAWN	AJH	2/97 DATE
CHECKED	MLL	2/97 DATE
APPROVED	DHK	2/97 DATE

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS * PLANNERS * SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9920 WASH. 821-4890

0 1000 2500 5000
SCALE (FEET)

MMR IMPACT AREA WORKPLAN

FIGURE 2-1
TRAINING RANGE AND
IMPACT AREA

SCALE: | CONTRACT NO.: 92307.012 | DATE: 2/97

DESIGNED	AJH	2/97 DATE
DRAWN	AJH	2/97 DATE
CHECKED	MLL	2/97 DATE
APPROVED	DHK	2/97 DATE

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS • PLANNERS • SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9920 WASH. 621-4680

0 1000 2500 5000
SCALE (FEET)

MMR IMPACT AREA WORKPLAN

FIGURE 2-2
GUN AND MORTAR POSITIONS,
RANGES, AND IMPACT AREA

SCALE: 1" = 2500' | CONTRACT NO.: 92307.012 | DATE: 2/97

The study area will be the training range and impact area located inside of Pocasset Forestdale Road, Burgoyne Road and Gibbs Road, the demolition areas and the Rod and Gun Club (Figure 2-2).

2.2.1 Physiography and Surface Waters

The Cape Cod peninsula was formed during the retreat of the glaciers at the end of the Ice Age. It consists of two distinct types of terrain resulting from the recession of two separate lobes of ice sheets. The training range and impact area are located on a broad, undulating glacial outwash plain with considerably more relief than the area to the south. The elevation generally ranges from 100 to 250 feet with the highest reported elevation of 306 feet above mean sea level (Massachusetts ARNG, 1985). The training range impact area is dotted with natural depressions called "kettle holes". Only one of these kettle holes, Succonsette Pond, which is located in the southwestern corner of the impact area buffer zone, contains water (Figure 2-3).

Due to the high permeability of the sands and gravel underlying the training range and impact area, there are no perennial streams, and very little to no run-off. This suggests that almost all precipitation in the training range and impact area ends up as groundwater recharge or evapotranspiration. The rapid infiltration of rainfall essentially eliminates surface water runoff and ponding - even in most kettle holes. Intermittent streams are only visible in a few drainage swales, and are only active during heavy rainfall. Succonsette Pond appears to be fed from groundwater flow-through, and run-off waters during heavy rainfall events. It has no surface water outflow. Topography of the range shows swales leading out of the impact area; others terminate within the range (USGS, 1976).

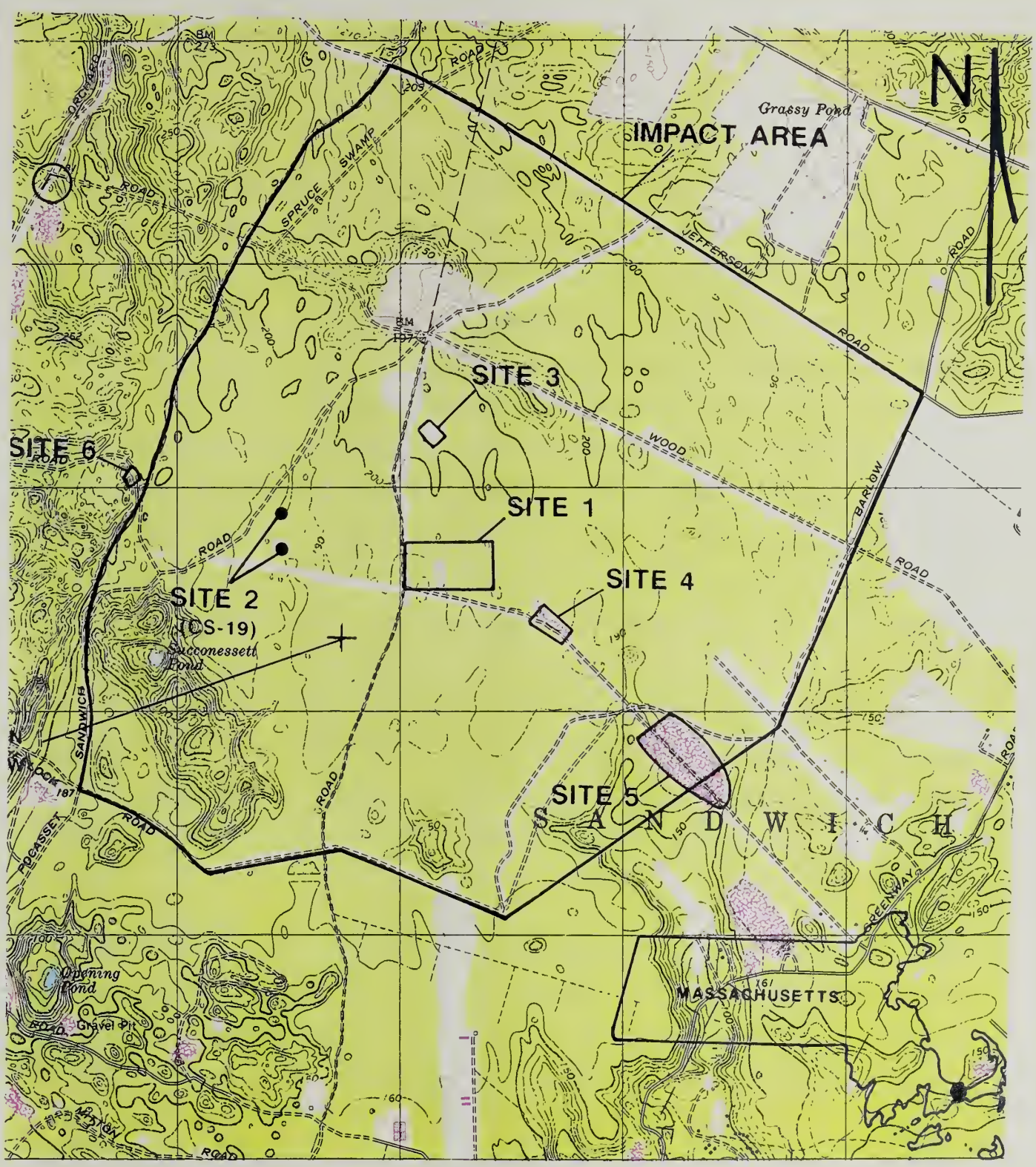


FIGURE 2-3

DESIGNED	DATE	ENGINEERING TECHNOLOGIES ASSOCIATES, INC.	PHYSIOGRAPHIC MAP OF THE TRAINING RANGE AND IMPACT AREA
DRAWN	DATE	ENGINEERS • PLANNERS • SURVEYORS	
CHECKED	DATE	3458 ELLICOTT CENTER DRIVE SUITE 101 ELLICOTT CITY, MARYLAND 21043 BALTO. 461-9920 WASH. 621-4690	
APPROVED	DATE		SCALE: / CONTRACT NO.: / DATE: / SHEET:

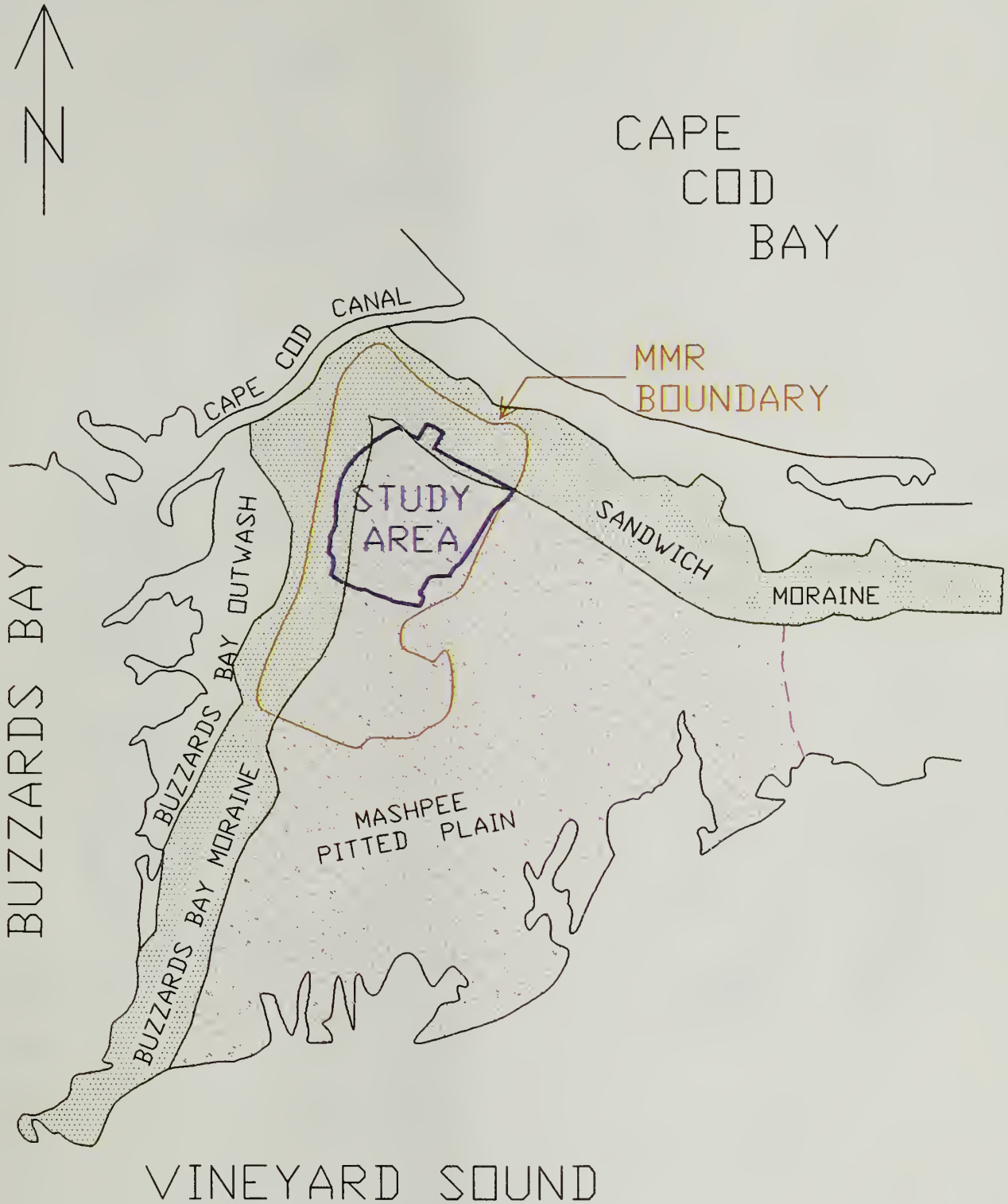
2.2.2 Geology

MMR is located within the Coastal Plain physiographic province. The predominant physical features are moraines and outwash plains composed of poorly sorted, heterogeneous mixtures of sands, silts, gravel, and boulders mixed with well sorted and stratified sands, gravel and silt. These geomorphologic features are a result of depositional processes associated with the advance and retreat of two ice sheets. Three distinct geologic units can be identified: the Sandwich Moraine in the north, the Mashpee Pitted Plain in the southeast, and the Buzzard Bay Moraine in the west (Figure 2-4). The training range and impact area is located on the north-central portion of MMR, which is underlain primarily by the Mashpee outwash plain. The geology is comprised of stratified, unconsolidated sands and gravels underlain by crystalline bedrock. The surface elevations typically vary between 100 and 140 feet above MSL in the outwash plains to about 300 feet above MSL in the moraines. The crystalline bedrock is at an average elevation of 150 feet below MSL (USAEHA, 1986).

The surface and subsurface soils are characterized by a heterogeneous mixture of cobbles, gravel, sand and silt to highly stratified sands and gravel. Typical of these soils are fine loamy topsoil overlying thick sand deposits or silty materials over stratified sand and gravel. All these deposits sit on a bedrock that has been mapped as a granodiorite (USGS, 1976).

2.2.3 Hydrogeology

The aquifer beneath MMR is part of the unconsolidated glacial deposits of Cape Cod, which constitutes the primary and sole source of potable water. The groundwater is under unconfined conditions with the highest groundwater surface elevations beneath the MMR. Therefore, groundwater flows radially in all directions from the Reservation (Figure 2-5).



Source: Aneptek, 1995

DESIGNED ____ DATE DRAWN ____ DATE CHECKED ____ DATE APPROVED ____ DATE	ENGINEERING TECHNOLOGIES ASSOCIATES, INC. ENGINEERS * PLANNERS * SURVEYORS 3458 ELLICOTT CENTER DRIVE SUITE 101 ELLICOTT CITY, MARYLAND 21043 BALTO. 461-6920 WASH. 621-4680	MMR IMPACT AREA STUDY FIGURE 2-4 AREA GEOLOGY	
		SCALE:	CONTRACT NO.: 92307.014 DATE: 3/1997 SHEET:

DESIGNED	AJH	2/97 DATE
DRAWN	AJH	2/97 DATE
CHECKED	MLL	2/97 DATE
APPROVED	DHK	2/97 DATE

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS * PLANNERS * SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9920 WASH. 621-4680

0 1000 2500 5000
SCALE (FEET)

MMR IMPACT AREA WORKPLAN

FIGURE 2-5
GROUNDWATER ELEVATION CONTOURS

SCALE: 1"=

CONTRACT NO.: 92307.012

DATE: 2/97

The training range and impact area is a major recharge area. It may be located above the apex of the groundwater system at MMR. Groundwater flow from the impact area may be multi-directional.

Recharge to the aquifer is from precipitation, averaging about 21 inches a year. The depth to groundwater can be as deep as 140 feet (ABB, 1992) in areas of high elevations in the training range and impact area, and has been documented to be about 115 feet at the IRP CS-19 study area in the impact area (USACHPPM, 1996). The unconsolidated sands and gravels are highly permeable with hydraulic conductivities between 200 and 300 feet per day. With average groundwater gradients of 0.003 percent, the groundwater flow velocity probably ranges between 0.8 to 2.3 feet per day (ft/d) (USGS, 1976). The vertical hydraulic conductivity appears to be relatively high, but lower than the horizontal. Data are limited on this subject, and the extent of anisotropy within the aquifer has not been defined.

2.3 Previous Investigations

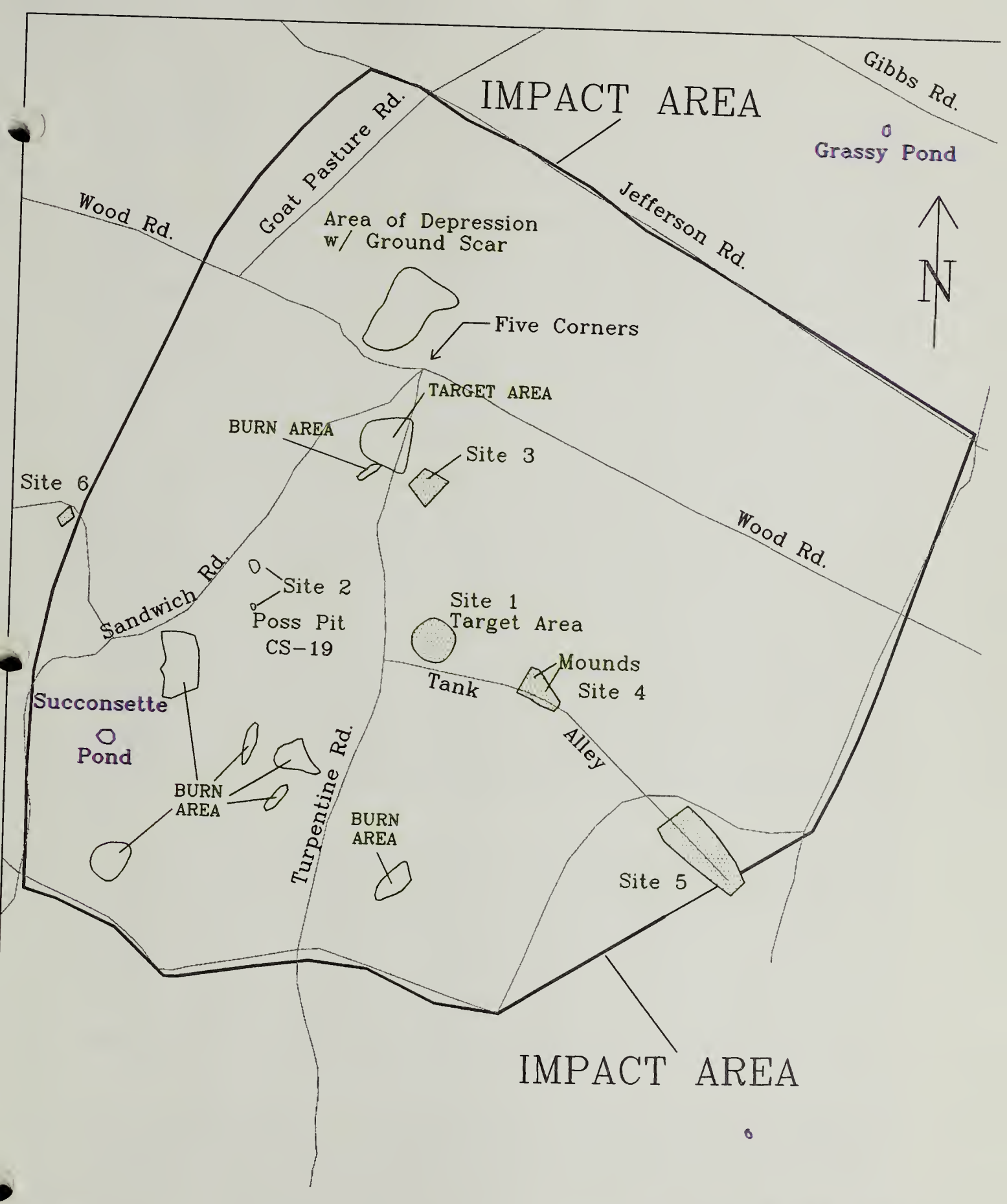
In 1987, the U.S. Army Environmental Hygiene Agency (USAEHA) conducted an investigation of ash remains from the burning of propellant bags at artillery and mortar positions. The scope of this study was limited to determining soil contamination from the ash remains. Two gun positions (GP-8 and GP-9), were selected as representative sites. These sites were investigated as Area of Concern-Chemical Spill -18 (AOC CS-18) under the Installation Restoration Program (IRP). Soil samples were collected from the top 18 inches at burn locations and analyzed for volatile and semi-volatile organics, heavy metals, and explosives. Some of these analytes were detected, but at acceptable levels for the current land use when compared to background levels, except for lead. Due to the fast decline in concentration levels with depth (90% decline within 6 inches of surface), the relative immobility of lead, and the depth to groundwater, the report concluded that the soils were not hazardous, and not an imminent source for environmental concerns. However, the report recommended further investigations. This was due to the lack of

specific regulations for contamination from explosives, the potential for change in the regulations, and the limitations of the laboratory techniques available at the time for detecting explosive compounds.

In 1994, the U. S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) conducted a follow-on study of the effects of burning propellant bags at two firing positions, GP-8 and GP-9. This study was a detailed investigation of the firing locations, and included soil and groundwater sampling. Soil samples were analyzed for heavy metals, explosives, and semi-volatile organic compounds (SVOCs). Groundwater samples were analyzed for volatile organic compounds (VOCs). The results of this investigation showed some explosives and heavy metals, mostly in the top one foot of soil. A preliminary risk evaluation (PRE) was conducted using these results. The study concluded there was no imminent danger to human health, and no current or expected threat of ecological risk exists from current or continued use of the sites.

Also in 1994, an aerial photographic site analysis (ERI, 1994) was conducted using aerial photographs dating back to 1943. This study was used in support of the CS-19 IRP investigation, but covered the whole training range and impact area in an effort to identify other sites suspected to be potential sources of past contamination. The analysis was conducted by viewing illuminated transparencies of aerial photos through a stereoscope. Stereoscopic magnification and viewing enables the analyst to identify characteristics associated with different environmental conditions based on color, texture, tone, shape, size and patterns associations. These characteristics allow specific objects and/or conditions to be recognized, and associated with specific activities and sites.

Six sites were clearly identifiable (Figure 2-6), with numerous areas showing varying levels of activity. Some of these areas went through several clearing and revegetation cycles between 1943 and 1991. Several ground scars, which are evidence of burning, were identified over the years, and the primary target areas showed small impact craters throughout the period studied (ERI, 1994).



DESIGNED AJH 12/96	ENGINEERING TECHNOLOGIES ASSOCIATES, INC.	MMR IMPACT AREA STUDY	
DRAWN AJH 12/96	ENGINEERS • PLANNERS • SURVEYORS	FIGURE 2-6	
CHECKED MLL 12/96	3458 ELLICOTT CENTER DRIVE SUITE 101 ELLICOTT CITY, MARYLAND 21043	AREAS of INTEREST	
APPROVED DHK 12/96	BALTO. 461-2828 WASH. 621-4258	BASED on AERIAL PHOTOGRAPHS	
		SCALE:	CONTRACT NO.: DATE: SHEET:

Under the IRP, a site investigation was conducted at the CS-19 location, identified as site #2 in the ERI study, within the impact area in 1992. This investigation included personnel interviews, geophysical surveys, and soil sampling. Soil samples were collected and analyzed for heavy metals, VOCs, SVOCs, herbicides, and polychlorinated biphenyls (PCBs). The geophysical surveys indicated that nearly all the identifiable anomalies were attributable to surface or subsurface metallic debris. The results of the laboratory analysis of soil samples indicated the presence of several organic and inorganic chemicals. The organics included one explosive compound, HMX (Cyclotetramethylene-tetranitramine), some pesticides including endrin ketone, alpha-BHC, heptachlor, 4,4-dichloro-diphenyldichloroethylene (DDE) and 4,4-dichlorodiphenyldichloroethane (DDD), endosulfan sulfate; some herbicides, dioxins, and furans. Inorganic chemicals detected included aluminum, chromium, copper, iron, lead, magnesium, manganese, mercury, vanadium, nickel, arsenic, barium, beryllium, cadmium, calcium, potassium, silver and zinc. Most of these compounds were detected in samples taken from surface to 3 feet deep. Based on the operational history, as narrated through interviews with past and present personnel, the levels of contamination detected and the behavior of these chemicals in the environment, the report concluded that groundwater contamination from this site is not likely (ABB, 1992).

As a follow-up to the 1992 study, four groundwater monitoring wells were installed at CS-19 to assess the effect of the site on groundwater. Analysis of samples from these wells indicated the presence of RDX (Cyclonite, an explosive compound) in two of the wells, suggesting that explosive chemicals had reached the groundwater table. The detection of RDX in the groundwater at CS-19 is suspected to be from past disposal practices(USACHPPM, 1994). The presence of RDX in groundwater also has precipitated a supplemental investigation by the IRP at CS-19.

The U.S. Army Engineers Waterways Experiment Station in Vicksburg, Mississippi has investigated the vertical migration potential of heavy metals at small arms ranges at MMR (Bricka,

1996-Draft Report). Soil samples were collected from borings varying in depth from surface to 90 feet, and analyzed using EPA methods SW-846. The potential for vertical migration was estimated using the one-dimensional advection-dispersion equation for non reactive, dissolved constituents. The predicted downward migration of metals in soils from historical small arms use occurs at the rate of approximately 2 to 3 inches per year. This figure is conservative, considering the low clay and organic matter content of the soils at MMR. Furthermore, the advection-dispersion equation assumes saturated, homogeneous and isotropic materials under uniform flow. Based on the results of this investigation, it seems that the conditions for vertical migration at the site are considerably more favorable than those at locations with more silty/clayey geological environments. These results are preliminary and approximate. Data gathered during this investigation will be used to refine the estimates of metal migration characteristics during the risk assessment.

2.4 Environmental Fate and Transport

Impact on ground water from munitions will be dependent on the physical and chemical characteristics of these compounds and their mobility in the subsurface environment. There are two classes of compounds that may reasonably be anticipated from munitions. The first is explosive compounds. There is a growing body of literature that addresses the environmental fate and transport of explosives. Explosives are subject to degradation and sorption in the subsurface environment. The second class of compounds are metals. Metals do not degrade since they are elements, but they are subject to chemical reactions and sorption.

2.4.1 Explosive Compounds

The literature on the environmental fate and mobility of explosive compounds focuses on TNT, RDX, and HMX. These were widely used high energy explosives and have been found in the environment at other sites.

2.4.1.1 TNT

2,4,6-trinitrotoluene (TNT) is a crystalline solid at room temperature. It is slightly soluble in water with a solubility of 130 mg/l (Urbanski, 1964 cited in McGrath, 1996).

TNT degrades both abiotically and as a microbiologically mediated reaction (Townsend and Meyers, 1996). Microbiogically mediated degradation is typically faster than abiotic and the reaction proceeds fastest under anaerobic (oxygen free) conditions (Townsend and Meyers, 1996). The principal degradation products are 2-amino-4,6-dinitrotoluene (2A-DNT), 4-amino-2,4-dinitrotoluene (4A-DNT) and 2,6-diamino-4-dinitrotoluene (2,6-DANT). There is evidence that these degradation products are also toxic (Honeycutt et al, 1996). Complete mineralization of TNT has been documented through cometabolism (TNT was not the only source of carbon for the microorganisms) under aerobic conditions (Gunnison et al, 1993).

Volatilization is not an important environmental process for TNT (McGrath, 1996).

Sorption is an important process affecting the mobility of TNT. Partition coefficients have been derived for a variety of surface soils although many of these studies failed to account for transformations of TNT during the experiments (Townsend and Meyers, 1996). Partition coefficients (sorption) are higher for clay and silt than sand. Although some investigators have found a correlation between organic carbon content and TNT sorption, the primary sorption mechanism is sorption on inorganic surfaces (Pennington and Patrick, 1990).

2.4.1.2 RDX and HMX

Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX or cyclonite) is a crystalline solid at room temperature. It is slightly soluble in water with a solubility of 42 mg/l (Sikka et al, 1980 cited in McGrath, 1996). Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetraazocine (HMX) is a crystalline solid

at room temperature. It is virtually insoluble; its solubility is 2.6 mg/l (Spanggord, 1982 cited in McGrath, 1996).

RDX and HMX degradation takes place only under anaerobic conditions. Although several investigators have noticed degradation of RDX and HMX under aerobic conditions, it only occurs in clay and silt soils where there may be microanaerobic zones where anaerobic degradation occurs. It is suspected that RDX and HMX degradation are microbiologically mediated processes. The degradation products of RDX and HMX are not known because of the lack of analytical protocols for these compounds (Townsend and Meyers, 1996).
Volatilization is not an important environmental process for RDX and HMX (McGrath, 1996).

Sorption is an important process affecting the mobility of RDX and HMX. Partition coefficients have been derived for a variety of surface soils (Townsend and Meyers, 1996). RDX is slightly less sorptive than HMX which in turn is less sorptive than TNT. The impact of organic carbon content on sorption is unknown, although partition coefficients (sorption) are higher for clay and silt than sand indicating that sorption to inorganic surfaces dominates.

2.4.1.3 Other Explosive Compounds

Other explosive compounds include N,2,4,6-tetranitro-N-methylaniline (tetryl), pentaerythritol tetranitrate (PETN), and ammonium picrate. Information on the environmental fate and effects of these compounds is limited. Their use in munitions was limited compared to TNT, RDX, and HMX. Environmental testing includes compounds such as 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitoluene (2,6-DNT) and 1,3,5-trinitrobenzene (TNB). These compounds are not used as explosives; they are byproducts of TNT manufacture and are typically found with TNT. They have been found at sites where contamination of the environment with TNT occurred.

2.4.2 Metals

The metals related to munitions are antimony (Sb), arsenic (As), barium (Ba), copper (Cu), iron (Fe), lead (Pb), mercury (Hg), and zinc (Zn). Antimony, As, Ba, Cu, Pb, Hg, and Zn are known as heavy metals. They normally only occur in trace amounts in uncontaminated aquifers. They have somewhat similar fate and transport properties. Their occurrence in ground water will be controlled by the oxidation state of ground water (generally the oxygen content), solubility and sorption onto inorganic surfaces. In the absence of reducing (no oxygen) conditions, these heavy metals are immobile in ground water. They exist in the subsurface adsorbed to iron and manganese hydroxides (Jacobs, 1997). Uncontaminated ground water at MMR is oxidizing, slightly acidic, and low in total dissolved solids, so heavy metals would be immobile. The recent investigation of inorganics in MMR ground water found that there were no sites with heavy metal contamination of ground water. All of the plumes that had elevated heavy metal concentrations could be explained by reducing conditions in the aquifer that allowed heavy metals to go into solution, or ground water samples had entrained suspended solids with sorbed heavy metals. (Jacobs, 1997).

The remaining metal related to munitions is Fe. Iron is ubiquitous in the Sagamore lens aquifer. Under normal aquifer geochemical conditions, aerobic and slightly acidic dissolved iron concentrations are extremely low (< 100 micrograms/liter) (Jacobs, 1997). The subsurface iron exists as ferric hydroxide, which is insoluble. In the absence organics in ground water causing reducing conditions, Fe will be immobile in the subsurface.

3.0 TASK EVALUATION AND SCOPE

This study is being conducted to determine the effects of military operations on the groundwater beneath the training ranges and impact area. The tasks are scoped to provide data on groundwater quality, verify the groundwater flow pattern in the study area, and provide for the preliminary evaluation of suspected source areas. This information will be used in the preliminary risk and groundwater quality evaluations. As more understanding of the hydrogeology of the area is gained, the scope of the study will be revised as needed. Additional investigation wells and/or soil samples will be used to collect data needed to characterize the level and extent of any contamination that may exist; and collect geotechnical and hydrogeological data to formulate policies for the long range protection of groundwater beneath the training ranges and impact area.

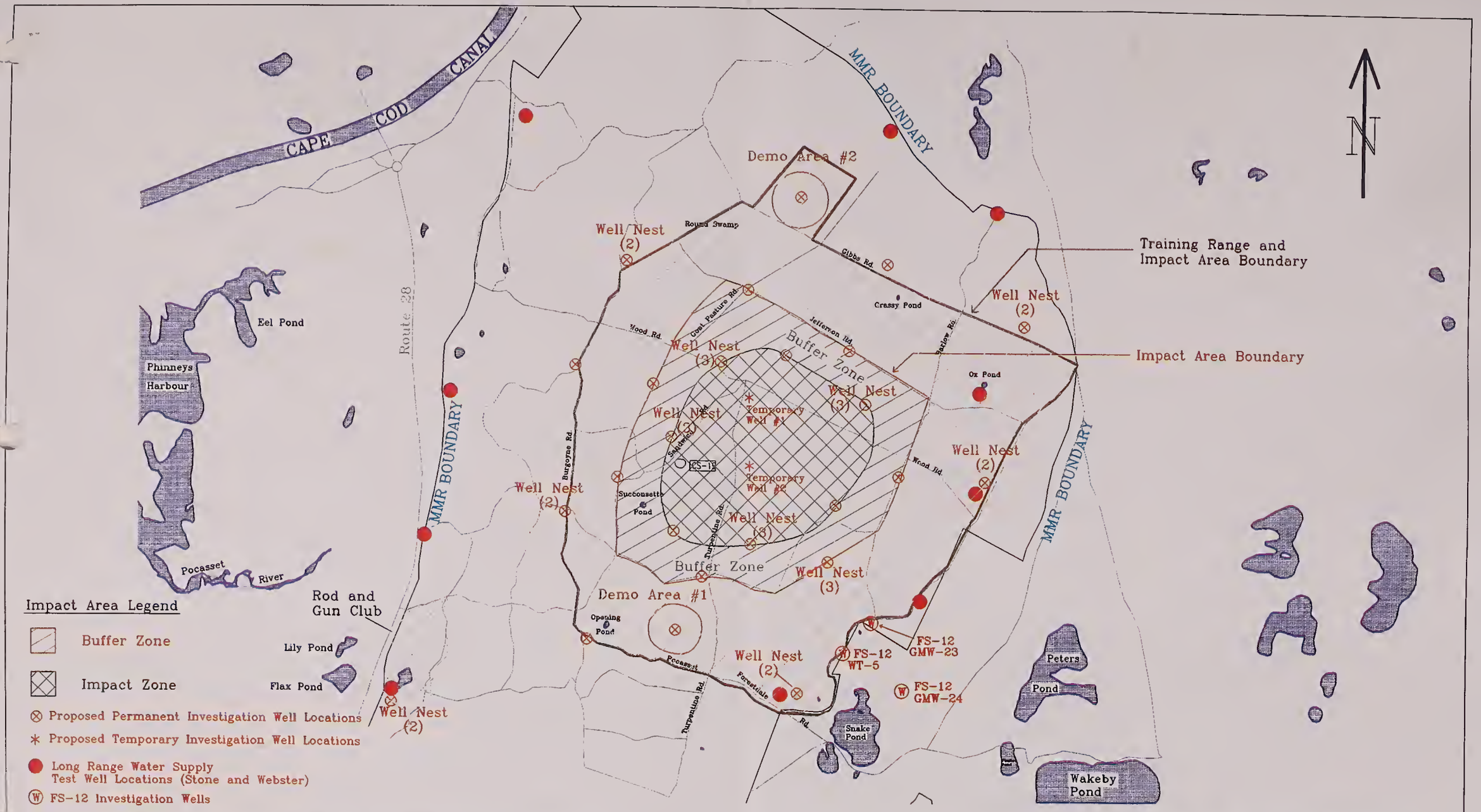
The initial scope of work for the training ranges and impact area study will include the installation of forty-one (41) permanent and two temporary ground water investigation wells; collection and chemical analysis of soil, surface water, sediments and groundwater samples; and the search for and review of records relating to the use of the site, fate and transport of suspected contaminants, and the general groundwater quality of the MMR. The investigation wells, supplemented by the LRWSPAT water source investigation test wells and IRP monitoring wells will provide control points for groundwater evaluation data that will be used to verify the groundwater flow model. Soil, surface water and sediment samples will provide data for the preliminary evaluation of suspected sources; and groundwater samples will provide data for the evaluation of the quality of groundwater beneath the study area. Additional investigation of suspected sources may be considered if the initial data warrants. Additional investigation wells and soil sample locations will be determined in consultation with the EPA.

Figure 3-1 shows the proposed investigation well locations. The locations of these wells were selected based on the current understanding of groundwater flow and anticipation of downgradient locations from the suspected source areas. The nested well locations are intended to investigate probable vertical gradients that may control fate and transport of contaminants. Also, in consideration of the current land use, personnel safety, and protection of the aquifer against contamination, investigation wells will be placed strategically around the perimeter of the impact zone.

The scope of the investigation will include the installation of investigation wells in and around the training range and impact area, the collection and analysis of environmental media, aquifer characterizations and the completion of a risk assessment. The new wells will be supplemented by selected IRP monitoring wells. This investigation well network will also include the potable water source investigation test wells installed by Stone and Webster earlier this year under contract to the Air Force Center for Environmental Excellence (AFCEE). The new and existing wells will be used to assess groundwater flow and quality beneath the training ranges and impact area.

Figure 3-1 shows the proposed locations for the permanent and temporary investigation wells. The temporary wells will be sampled immediately after installation, and upon receipt of the laboratory results of analysis, the casing will be pulled and the boring grouted to the surface. The locations of all investigation wells will be selected based on ground water flow as data becomes available, and after consultation with the EPA.

Figure 3-2 shows locations for soil, surface water and sediments sampling. The scope of this sampling is designed to provide for preliminary evaluation of potential sources and probable



SIGNED	AJH	2/97 DATE
DRAWN	AJH	2/97 DATE
CHECKED	MLL	2/97 DATE
APPROVED	DHK	2/97 DATE

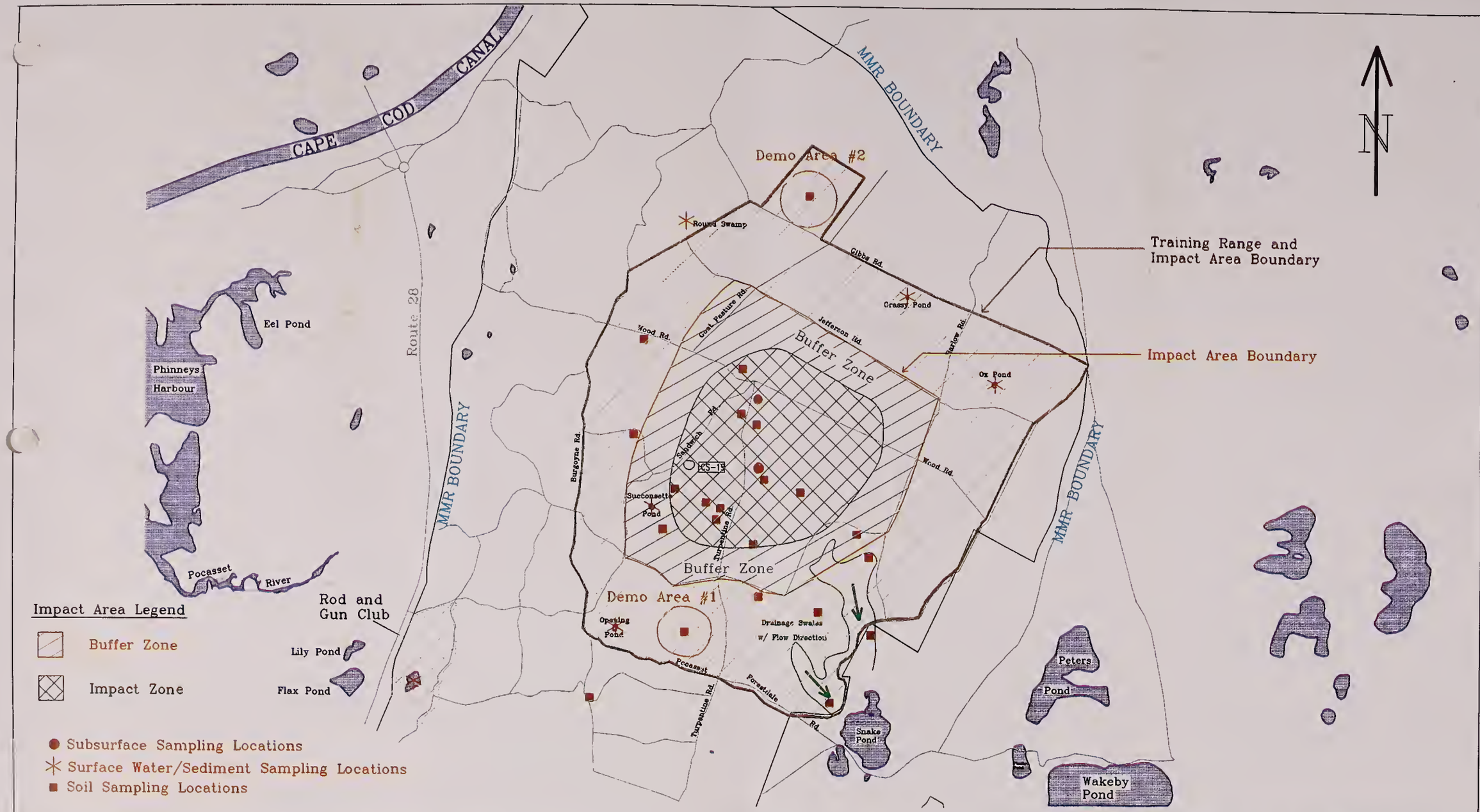
ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS • PLANNERS • SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9920 WASH. 621-4680

0 1000 2500 5000
SCALE (FEET)

MMR IMPACT AREA WORKPLAN

FIGURE 3-1
PROPOSED MONITORING WELLS
LOCATION MAP

SCALE:	CONTRACT NO.: 92307.012	DATE: 2/97



DESIGNED	AJH	2/97
DRAWN	AJH	2/97
CHECKED	MLL	2/97
APPROVED	DHK	2/97

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS * PLANNERS * SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9920 WASH. 621-4680

0 1000 2500 5000
SCALE (FEET)

29

MMR IMPACT AREA WORKPLAN
FIGURE 3-2
SOIL, SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS

SCALE: | CONTRACT NO.: 92307.012 | DATE: 2/97

migratory routes of contamination. Surface soil samples will be collected at seventeen smaller sites within the study area, including the two demolition areas, the two target areas, the five probable sources, seven burn areas and one ground scar area, as identified by the ERI report. Surface water and sediment samples will be collected from four ponds and a swamp. The sampling at suspected sources will be done on a grid system. The grids will be based on a review of aerial photographs to identify the most heavily used areas (focal zone) of the suspected areas for sampling. Sampling locations in drainage swales will be based on topography, visual field observations and historical use of the areas contributing flow to the drainage. Groundwater samples will be collected from all the new wells, approximately twelve IRP wells, and the LRWSPAT test wells.

The primary compounds of interest are those derived from munitions and their degradation byproducts. Therefore, the focus of the analytical program will be to identify compounds relating to explosives. Furthermore, the sampling and analytical programs will be designed to attempt to distinguish compounds derived from explosives, and those resulting from other activities not related to typical range activities. However, for completeness, and in order to comply with the MMR IRP Quality Assurance/Quality Control (QA/QC) guidelines for analytical programs for environmental investigations at MMR, the list of analytes will include Target Analyte List Inorganics (TAL inorganics), Target Compound List Volatile Organic Compounds (TCL VOCs) and Target Compound List Semi-Volatile Organic Compounds (TCL SVOCs), TCL for Pesticides/PCBs, Herbicides, Ethylene Dibromide (EDB) and Methyl-Tert-Butyl-Ether (MTBE).

3.1 Investigation

The history of the numerous ranges, their use and types of munitions used over the years is uncertain. However, some previous investigations (USAEHA, 1987; USACHPMM, 1994) at typical ranges, artillery and mortar locations, and the CS-19 site (see Figure 3-1) located within the training range and impact area have provided adequate characterization of these sites, so the

focus of this investigation will be the impact area itself.

3.1.1 Archives Search

The historical use of the impact area over the last 10 years has been well documented, but the previous 50 years was not. Therefore, a thorough search of archives will be undertaken to locate, identify, and review historical information about the type and amounts of munitions used at the MMR. An extensive search has been initiated and will continue to include records from other military installations for similar periods. This search will also include interviews with past employees at the post and the investigation of all unconfirmed incidents of improper and/or accidental disposal within the impact area.

3.1.2 Review of Aerial Photographs

The data requirements of this project will include the review of new and historical aerial photographs. Aerial photographs will be analyzed to identify historically heavily used areas for soil sampling. These heavily used areas are the most probable sites where soil contamination may have occurred. An aerial photographic analysis of the impact area identified six probable sites, which included CS-19, and numerous other locations of interest for environmental investigation (ERI, 1994).

3.1.3 Unexploded Ordnance Survey

All access roads, investigation well and soil sampling locations will be surveyed and cleared for unexploded ordnance (UXO) before the investigation. All sampling sites will be surveyed and cleared of UXO within a 5-foot radius. The depth of UXO screening during boring for investigation well location will be determined by the result of modeling currently being conducted at Huntsville District Corp of Engineers. Similarly, in the event of subsurface sampling within the impact area, the depth to which the sampling will go may depend on the result of the Huntsville modeling.

3.1.4 Surface Water, Soil and Sediments Sampling

Figure 3-2 is a map showing proposed locations for surface water, surface soil and sediments sampling. Natural depressions and swales will be investigated as probable conduits and areas of compound accumulation resulting from storm water run-off. Subsurface soil samples will also be collected during borehole completion for both permanent and temporary investigation well installation. The locations for these investigation wells are shown on Figure 3-1.

3.1.4.1 Surface Water and Sediments Sampling

Surface water and sediment samples will be collected from four ponds in the training range and impact area, one pond at the Rod and Gun Club, and one swamp location just north of the impact area. Most kettle holes in the study area are dry, and only collect water during and immediately after large rainstorms before it all infiltrates and/or evaporates (see Section 3.1.4.4 Stormwater Sampling). However, the swamp area and four of these kettle holes appear to be deep enough to possibly intersect groundwater. They provide additional locations for sampling groundwater.

3.1.4.2 Soil Sampling

The soil sampling program will consist of a two tier program including

(i) surface soil sampling, and

(ii) soil boring for lithologic logging at investigation well location.

Surface soil sampling will be conducted at the two demo areas, two target areas, the five potential source areas, and eight burn areas, as depicted by the ERI report; drainage swales and surface depressions. At suspected source areas, each area will be reviewed to determine the "Focal Area" - the area that receives the heaviest and persistent use. The focal area will be gridded on a 50 meter grid while the rest of the area will be on a 100 meter grid. Discrete soil samples will be collected within each grid. Figure 3-3 is an example of the gridding and sampling location for Target area #1. This area is an 8.25 acre area with a Focal area of 6 acres.

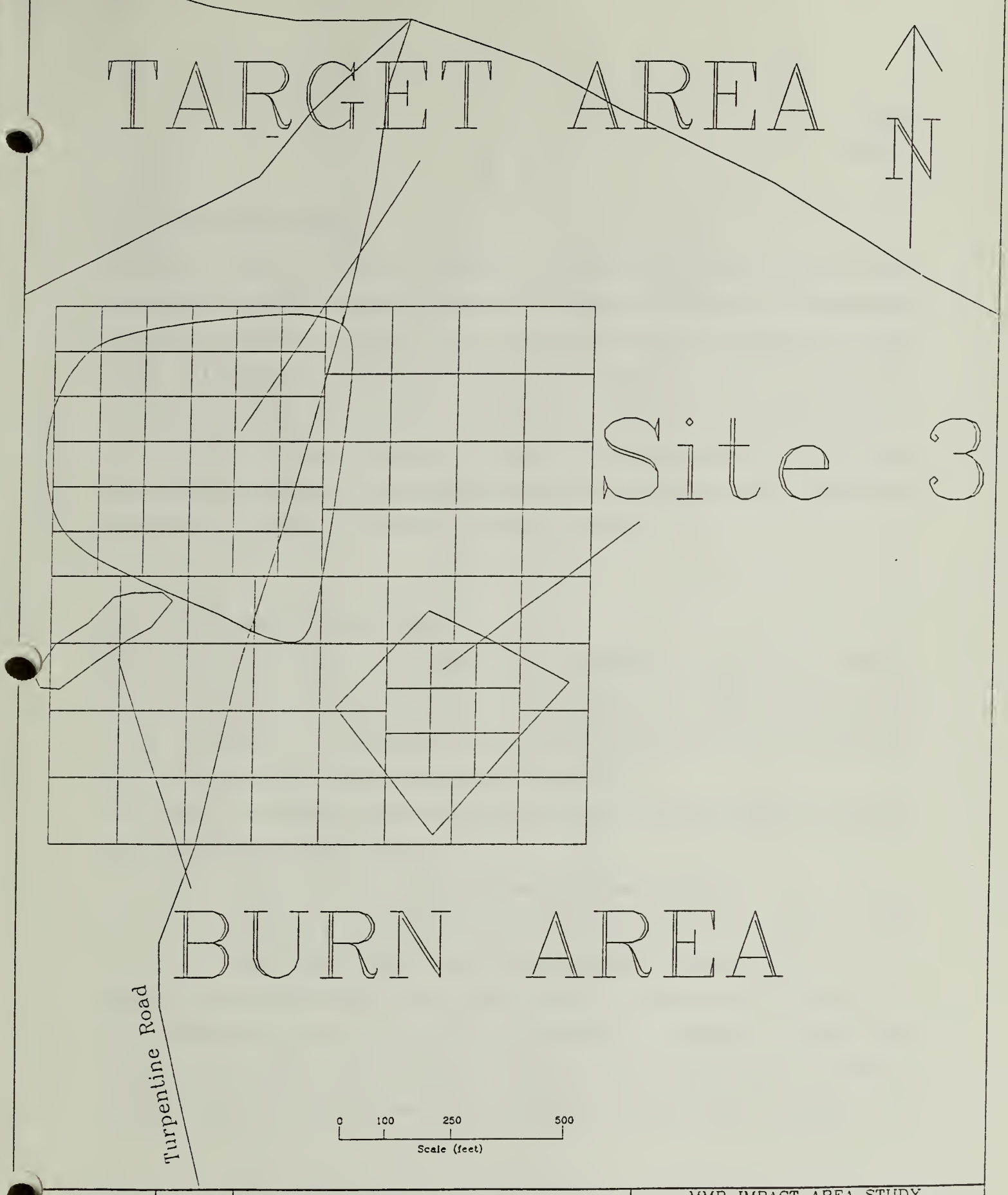
A total of 41 soil samples will be collected, 34 at the focal area and 7 at other areas. Similarly, for all the other areas of concern, a total of 415 surface soil samples will be collected for analysis.

During investigation well installation, subsurface soils will be sampled continuously using a 10-foot core barrel. The samples will be used for lithologic logging and field screening using a Flame Ionization Detector (FID). A determination will be made in the field based on FID readings whether any of the samples will be submitted for laboratory analysis.

Subsurface sampling locations at areas where contamination may be expected to occur at depth will be determined through surface sampling analysis, site characterization, archival information, interview results and consultation with the EPA. At all temporary well locations within the impact area, subsurface soil samples will be collected every ten feet of depth. The analytes list for these samples will include explosive compounds and metals, and additional analytes for these samples will be determined in consultation with the EPA.

3.1.4.3 Groundwater Sampling

Upon completion of investigation wells installation, and after allowing enough time for stabilization, groundwater samples will be collected for analysis. Groundwater samples will be collected for all newly installed wells, the ten LRWSPAT test wells, and twelve IRP monitoring wells. Before sampling, the depth to groundwater in each well will be measured and recorded. That information will be augmented by water level measurement from NSGS, IRP, and LRWSPAT monitoring wells in and around the study area.



DESIGNED	MLL	3/97
DRAWN	AJH	3/97
CHECKED	MLL	3/97
APPROVED	DHK	3/97

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS • PLANNERS • SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9920 WASH. 521-4990

MMR IMPACT AREA STUDY

Figure 3-3
Typical Soil Sampling Grid

SCALE:	CONTRACT NO.:	DATE:	SHEET:

3.1.4.4 Stormwater Sampling

Because of the sandy soils and lack of impervious surface within the impact area, there is very little stormwater runoff as described in Section 2.2.1. Precipitation infiltrates into the sandy soils and becomes ground water recharge. Only the largest storm events will generate stormwater runoff. Most kettle holes in the study area are dry, and only collect water during and immediately after large rainstorms before it all infiltrates and/or evaporates. Sediment samples will be collected from areas where stormwater flows off the impact area and from dry kettle holes within the impact area. A comprehensive stormwater sampling plan will be developed in accordance with 40 CFR 122.21 and in consultation with the EPA.

3.1.5 Investigation Well Installation

The scope of the investigation well installation will initially include forty one permanent and two temporary wells. The number and locations of wells will be subject to change and revision in the field as data gathered is reviewed, and as we gain a better understanding of the hydrogeology of the site. All changes will be made in consultation with the EPA.

The monitor well installation program will be required to provide groundwater data collection points, and hydrologic control points to:

(i) Assess the quality of groundwater beneath the study area; and

(ii) Provide a good understanding of groundwater levels and movement -- both horizontal and vertical-- to help understand the flow of groundwater.

Initially, twenty-five locations have been selected to install forty-one permanent wells (See Figure 3-1). At twelve of these locations, a nest of two or three wells will be installed. The depths of the investigation wells and the screening intervals will be determined in the field by the results of laboratory analysis of groundwater samples collected during borehole drilling for investigation well

installation. Well depth will vary from approximately ten feet into the water table to just above the Sagamore Silty Clay layer that constitutes the bottom of the aquifer (USGS, 1996). Initially, two locations in the impact zone have been selected for the placement of temporary wells.

At each well location, a boring will be drilled from surface to the bottom of the aquifer. Soil samples will be collected continuously using a 10-foot core barrel for geologic logging of the boring, field screening and chemical analysis. Groundwater samples will be collected at 10 foot intervals for groundwater column characterization. Due to the lack of analytical procedures to provide real time analytical results for TNT and RDX, all samples will be submitted to an on-site laboratory for analysis and a 24-hour turn around. HPLC-8330 normally requires 15 hours for sample preparation and 24 hours turn around. Therefore, samples will be analyzed at a laboratory on-site with 24 hour turn around. Temporary wells will then be withdrawn and grouted to the surface after the laboratory releases the analytical results.

Investigation wells will be drilled and installed by a licensed driller under the supervision of a qualified geologist or hydrogeologist who will log the boring, collect and prepare samples, and document well completion. For purposes of this project, the hydrogeologist/field supervisor for the drilling program will be required to keep a detailed record of the daily activities. This record will include but is not limited to drilling conditions, problems encountered and the methods employed to resolve them, weather conditions, and any condition and/or activity bearing effects on data quality and procedures.The borings for the wells will be drilled using rotasonic drilling technique to drill an 8-inch diameter boring. Rotasonic drilling is a drilling methods that uses high frequency mechanical vibrations to push dual casings and collect continuous core samples of the overburden and most bedrock formations. The system has many advantages over conventional auger drilling, but the two that are most unique for the conditions at MMR are the abilities to obtain continuous, undisturbed core samples of the sands and to drill through boulders, concrete and debris, thus alleviating the problems that have been encountered by auger refusal at shallow depth.

A core barrel will be pushed ahead of an outer casing using a hydraulic press to collect samples. The core samples will be used to log the boring and collect subsurface soil samples for chemical and geotechnical analysis. Soil and groundwater samples will be analyzed on site to characterize the saturated zone of the aquifer. The results will be used to determine screening intervals for the investigation wells.

After the desired depth is reached, the investigation wells will be installed using 10 feet of 0.010-inch factory slotted Schedule 80 polyvinyl chloride (PVC) well screens and the appropriate length of risers to provide for a 2-foot stick-up above surface. After installation of the well screen, risers and well construction materials, the outer casing is vibrated back out of the borehole. The vibration positively places well construction materials around the screen and risers.

Upon completion and after a stabilization period of at least seven days, each well will be developed using the surge and pump method as outlined in the MMR-SOP manual. Well development will be considered complete when the temperature, turbidity, conductivity and pH of the water stabilizes within 10 percent for three consecutive readings.

At locations where nested wells are installed, the deepest well will be installed first. The borings for the other wells in the nest will be completed using PVC disposable knock-out plugs. The borings for these well will be completed without any soil or groundwater sampling.

3.1.6 Elevation and Location Survey of Investigation wells

A licensed surveyor will locate investigation wells installed during this investigation. The coordinates of the wells will be presented in the Massachusetts State Plane Coordinate System North American Datum of 1927. Vertical surveys of the wells will be based on the National Geodetic Vertical Datum of 1929. Horizontal and vertical accuracy of the surveyed location will be within 0.01 feet. Well stickup from ground surface will be determined for the well and

protective casings with the same level of accuracy. A permanent marker will be placed at the points of measurement on each casing.

3.1.7 Well Site Clean-up and Restoration

After completion of field activities at all sampling and investigation well locations, all equipment and materials not associated with the well itself will be promptly removed. The area will be restored to its original condition by removing trash, excess grout and concrete and grading to remove ruts. Seeding, mulching and general landscaping may be required. All drill cuttings and well development waters will be containerized, unless otherwise specified by the field supervisor.

3.1.8 Water Level Measurements

Subsequent to the completion of the survey, groundwater levels in the investigation wells will be measured and recorded using an electronic measuring device. The probe of the device is lowered into the well until it hits the water table. A continuous tone is emitted when the probe contacts water. The depth to water is read off the calibrated tape to which the probe is attached. Water levels will be measured with 0.01 foot accuracy; and the data, together with surveying data used to generate a groundwater elevation map.

3.1.9 Aquifer Testing

Aquifer testing will be conducted in an attempt to identify the hydrogeologic conditions and controls on groundwater flow and contaminant transport. The objective of this testing will be to qualitatively determine aquifer parameters that control flow patterns and to determine the relationship between these flow patterns and the transport of any contamination that might exist. Further still, the results of this effort will be used to refine existing models to predict the regional flow and transport for the whole installation. The activities of this task will include slug and/or

pumping tests to estimate hydraulic conductivity and determine the relative permeability and conductivity of the various strata being monitored at the site.

3.2 Preliminary Risk Evaluation

A Preliminary Risk Evaluation (PRE) will be conducted. A PRE is a screening-level risk assessment that supports risk management decision making. The PRE will identify those compounds of concern which are found in concentrations that may have potential adverse effects on humans and ecological receptors.

The PRE will be conducted using the Tier I procedure and guidelines provided in the MMR Risk Assessment Handbook, Volumes I and II, Massachusetts Military Reservation (CDM, September 1994), updated to meet the focus of this study. Preliminary risk evaluation screening procedures (Tier I) are designed to conservatively identify sites that require further investigation. They are designed to be conservative; identifying sites that, in fact, may not present any actual risk.

As data becomes available, a human health and ecological risk assessment will be initiated. The risk assessment will be conducted in accordance with guidelines provided in the MMR-RAH. the public health risk assessment will consist of five principal components, including hazard identification, close response assessment, exposure assessment, risk characterization, and limitations/uncertainties. Fate and transport modeling will be considered to suppport the risk assessment. The estimated risk values will be continuously refined as more data is collected over the duration of the field work, and a final risk assessment result included in the final investigation report.

3.3 Follow-on Actions

The following actions may be required to fulfill the goals of the EPA Region I Administrative Order.

3.3.1 Risk Assessments

The Army National Guard, in consultation with EPA, will complete human health risk and ecological risk assessments. The Army National Guard will partner with other federal agencies who are recognized experts in the risk assessment field. These agencies will work with the supervising contractor to gather information, augment existing data and complete the risk assessments. These risk assessments will include modeling the fate and transport of all contaminants found as a result of this investigation and will be used during the development of any required response plans and the long term monitoring program.

3.3.2 Response Plans

Response plans will be prepared and implemented as conditions warrant. All data evaluation will be conducted in consultation with EPA. At any time sample results indicate additional investigation is required at a particular site, the ARNG will direct the supervising contractor to prepare a response plan. The preparation of the response plan will be coordinated with EPA, MADEP and the IRP. ARNG will brief the citizens advisory committee of the need for and contents of the response plan. The response plan will be initiated immediately after receiving approval of the plans contents from EPA.

3.3.3 Installation Response Program (IRP) Investigation Referral

Throughout the duration of this investigation, the ARNG will coordinate with the IRP. All data gathered during the investigation will be made available to the IRP. A partnership will be established with IRP to ensure all response plans are coordinated. In the event that a source of contamination is located and determined to be eligible for inclusion in the IRP, the partnership

ensure that the proper investigation is conducted. The proper agency will develop any required response plan and will ensure all necessary actions are taken to comply with that plan.

3.3.4 Long Term Monitoring Program

After the initial data has been gathered and the groundwater model has been verified, ARNG may develop a long term monitoring program. This monitoring program will be developed in consultation with EPA, USGS, MADEP and the LRWSPAT. Additional input may be requested from the IRP and other federal agencies. The long term monitoring plan will be developed using the results of the groundwater modeling, the risk assessments and source evaluations. Additional permanent wells may be installed in support of the long term monitoring program.

4.0 SAMPLING AND ANALYSIS

4.1 Sampling Program

During the field work, environmental samples will be collected from surface soils, subsurface soils, surface water, sediments and groundwater for laboratory chemical analysis. All field activities will be conducted according to standard operating procedures outlined in the MMR-IRP "Standard Operating Procedures for Environmental Investigations at MMR" (CDM, 1993) subject to the changes proposed in this work plan. Table 4-1 summarizes the initial sampling program, showing the number and types of samples to be collected, sampling locations and analytical methods. Soil samples will be subjected to headspace screening in the field, and water samples will be analyzed in the field for temperature, conductivity and pH.

4.1.1 Field Screening

All soil samples collected during this investigation will be subjected to headspace screening. This will be done by filling half of a 4-oz. glass jar with portions of the sample. The jar will be covered with aluminum foil and a lid, and allowed to equilibrate at room temperature (70° F) for approximately 15 minutes. This will allow any volatile organics in the sample to equilibrate within the air in the headspace above the sample. The probe of a Flame Ionization Detector (FID) will then be inserted through the aluminum foil into the headspace. The reading registered on the FID will be recorded.

4.1.2 Well Installation

Investigation wells will be installed at the locations proposed in Section 3.1.5 of this work plan and at additional locations as needed based on the evaluation of data collected during the study in consultation with the EPA.

TABLE 4-1 SAMPLE TYPES, NUMBER AND ANALYSIS

SOIL/SEDIMENT SAMPLES	Number of Samples	Explosive	TAL Metals	TCL Volatiles	TCL Semi-Volatiles	Pesticides	PCBs	Herbicides	Cyanide	EDB MTBE	TCLP
Surface/Sediment	415	415	415	125	125	125	125	125	125	125	
Subsurface	49	49	49	15	15	15	15	15	15	15	
Sediment	20	20	20	6	6	6	6	6	6	6	
Field Duplicates	46	46	46	14	14	14	14	14	14	14	
MS/MSD	46	46	46	14	14	14	14	14	14	14	
Disposal Analysis	10										10
TOTAL NUMBER OF SOIL/ SEDIMENT SAMPLES	586	576	576	174	174	174	174	174	174	174	10
AQEOUS SAMPLES	Number of Samples	Explosive	TAL Metals	TCL Volatiles	TCL Semi-Volatiles	Pesticides	PCBs	Herbicides	Cyanide	EDB MTBE	TCLP
Surface Water	5	5	5	2	2	2	2	2	2	2	
New Wells	43	43	43	13	13	13	13	13	13	13	
Existing Wells	24	24	24	7	7	7	7	7	7	7	
Field Blanks	8	8	8	2	2	2	2	2	2	2	
Trip Blank	8	8	8	2	2	2	2	2	2	2	
Equipment Rinsates	40	40	40	12	12	12	12	12	12	12	
Field Duplicates	9	9	9	3	3	3	3	3	3	3	
MS/MSD	9	9	9	3	3	3	3	3	3	3	
Disposal Analysis	10										10
TOTAL NUMBER OF AQUEOUS SAMPLES	156	146	146	44	44	44	44	44	44	44	10

Permanent investigation wells will be drilled and installed by a licensed driller under the supervision of a qualified geologist or hydrogeologist who will log the boring and document well completion. The borings for the wells will be drilled using rotasonic drilling technique or hollow stem auger depending on proposed boring depth. Rotosonic drilling is a drilling methods that uses high frequency mechanical vibrations to push dual casings and collect continuous core samples of the overburden and most bedrock formations. The system has many advantages over conventional drilling, but the two that are most unique for the conditions at MMR are the abilities to obtain continuous, undisturbed core samples of the sands and to drill through boulders, concrete and debris, thus alleviating the problems that have been encountered by auger refusal at shallow depths.

When rotosonic drilling is employed, a 4-inch diameter core barrel will be pushed ahead of an 8-inch outer casing using a hydraulic press to collect core samples. The core samples will be used to log the boring. For the initial boring at each well or well nest location, groundwater samples will be collected every 10 feet and analyzed to characterize the saturated zone of the aquifer. These results will be used to determine screening intervals for additional investigation wells at this location. After the desired depth is reached, the investigation wells will be installed using 10 feet of 0.010-inch factory slotted Schedule 80 polyvinyl chloride (PVC) well screens and the appropriate length risers to provide for a 2-foot stick-up above surface. After installation of the well screen and risers, the outer casing is vibrated back out of the borehole. The vibration positively places well construction materials around the screen and risers.

A similar procedure will be followed when using hollow stem augers. Lithologic samples will be collected every five feet using a split spoon. For the initial well at each location, ground water samples will be collected every ten feet through a screened auger section (see MMR SOP 4-7, CDM, 1993). Well construction will be identical to that proposed above.

Upon completion and after a stabilization period of at least seven days, each well will be developed using the surge and pump method as outlined in the MMR SOP 4-3 (CDM, 1993). Well development will be considered complete when the temperature, turbidity, conductivity and pH of the water stabilizes within 10 percent for three consecutive readings.

Temporary investigation wells will be drilled using the same procedures described above for permanent wells. These boreholes will be advanced to the silty layer at the bottom of the aquifer. Samples of soil and water will be collected every ten feet during drilling. The drill casings will remain in the borehole until analysis results are available from the laboratory. After the results are received, the casings will be pulled and the borehole grouted to the surface.

4.1.4 Surface Water/Sediment Sampling

Surface water samples will be collected from ponds in and around the impact area as described in Section 3.1.4. Surface water samples will be collected using the procedure in MMR SOP 1-1 (CDM, 1993).

Sediment samples will be collected at the same locations as surface water samples are collected. Sediment samples will also be collected from swales and kettleholes where stormwater runoff from the impact area concentrates as described in Section 3.1.4. Sediment samples at surface water sampling locations will be collected using the procedure in MMR SOP 1-1 (CDM, 1993). Sediment samples in swales, where there is no water, will be collected using the procedures for surface soil sampling (described in Section 3.1.4.2 and MMR SOP 1-3). Samples will be collected on the longitudinal axis of the swale or kettlehole at 50 meter intervals. Three samples will be collected at each interval. One sample will be collected at the deepest part of the swale or kettlehole (thalweg) and two samples will be collected on either side at an elevation one foot above the deepest point. Swale or kettlehole sediment samples will be collected to a maximum depth of six inches using the procedures in MMR SOP 1-3 (CDM, 1993).

4.1.4 Soil Sampling

Surface soil sampling will be conducted at disturbed areas within the impact zone as described in Section 3.1.4.2. At the target zones and areas identified as potential source areas, discrete samples will be collected. A grid with a 50 meter spacing will be overlaid on the focal area of the potential source. A surface soil sample will be collected at the center of each grid following the procedures in MMR SOP 1-1. Surface soil samples will be collected to a maximum depth of two

feet. As mentioned above, all soil samples will be screened with the FID. The soil samples with the highest readings on the FID will be submitted to the laboratory for the complete analysis, which includes VOCs, SVOCs, EDB, MTBE, and pesticides/PCBs.

Outside the focal area of the potential source, a grid with a spacing of 100 meters will be overlaid. A surface soil sample will be collected at the center of each grid following the procedures in MMR SOP 1-1 (CDM, 1993). Surface soil samples will be collected to a maximum depth of two feet.

In ground scar and burn areas as identified in Section 3.1.4.2, composite surface soil samples will be collected. A 50 meter spaced grid will be overlaid on each ground scar and burn area. Surface soil samples will be collected at the center of each grid following the procedures in MMR SOP 1-1 (CDM, 1993). Samples from each eight grid section (a total of 20,000 square meters or about 5 acres) or less for small sites will be composited following the procedures in MMR SOP 2-3 (CDM, 1993). Composited samples will only be analyzed for explosives and TAL inorganics. The compositing procedure results in losses of VOCs and possibly SVOCs from the samples (see MMR SOP 2-3, CDM, 1993). At least one discrete sample, in addition to the composite sample, will be collected from each ground scar and burn area. This discrete sample will be submitted for a complete analysis that includes VOCs, SVOCs, EDB, MTBE, and pesticides/PCBs.

Subsurface soil samples will be collected every ten feet during drilling at temporary well sites in the impact zone. Subsurface soil samples will be collected every 30 feet during drilling at sites expected to have contaminants at depth as determined through site characterization, archival search, surface soil analysis, and consultation with the EPA.

As the study progresses and analytical results are received, additional soil sampling may be conducted. Additional analysis requirements will be determined in consultation with the EPA.

4.1.5 Water Level Measurements

After installation and a stabilization period of at least seven days, the water levels in all new and some existing wells around the training range and impact area will be measured using an audible electric water level measuring device. The device is lowered into the well and detects sounds that indicate the presence of water. The depth to water shall be measured from the reference mark at the top of the well casing, to an accuracy of 0.01 feet. The depth to water will be recorded in a field notebook (see MMR SOP 1-6, CDM, 1993).

4.1.6 Groundwater Sampling

Groundwater samples will be collected from each new investigation well and some of the existing IRP and LRWSPAT test wells. These samples will be analyzed for explosive compounds, TAL inorganics, TCL VOCs and TCL SVOCs, TCL pesticides/PCBs and herbicides, ethylene dibromide (EDB), and methyl-tertiary-butyl ether (MTBE).

After a seven-day stabilization period, all investigation wells will be sampled. Prior to sampling, each well shall be purged using the EPA low-flow purge and sampling procedure (see Appendix C). Samples bottles will be filled according to the analytical requirements. All groundwater samples will be analyzed for explosive compounds and the TAL inorganic parameters. Selected groundwater samples will be analyzed for VOCs, SVOCs, and pesticides/PCBs. The selection will be based on location downgradient of suspected sources and hydrologic considerations.
The samples for volatile organic analyses will be collected in two 40-ml vials, ensuring no air bubbles are entrained in the sample. The samples will be preserved with hydrochloric acid (HCl) to a pH less than 2. Pre-sampling preservation tests at each well will ensure proper preservation of the samples. The remaining sample bottles will be filled after the VOC samples are collected. All samples will be collected by allowing water to flow into the container with a minimum of disturbance. For samples requiring preservatives, the preservative will be added to the container before the water. Filtered samples will be filtered through a 0.45-micron filter using a peristaltic pump, with the filter attached to the discharge port. All samples will be labeled and immediately placed on ice for delivery to the laboratory. A chain of custody and field record will be maintained for all samples (see MMR SOP 1-2, CDM, 1993).

4.1.7 Sample Designations and Identification

For tracking purposes, samples will be designated and identified according to the MMR protocol, using 14 alphanumeric characters. The 14 alphanumeric characters will constitute six information groups:

(i) The first two characters denote a site code, which usually is a number between 01 and 99 assigned to a site at the time of initial information gathering. The site code for the training range and impact area will be 71.

(ii) The next two characters denote sample types. The general nomenclature of this code is as follows:

BS: Soil boring sample
BW: Groundwater sample from a boring
GB: Water sample from a geologic boring
MS: Investigation well soil sample
MW: Groundwater sample from a investigation well
QS: Equipment rinsate sample
QT: Trip blanks
QW: Source water sample
WT: Water table sample

(iii) The next three characters represent the horizontal locator, which in this case will be the well numbers. The horizontal locator consists of numbers ranging from 001 up to the total number of wells installed.

(iv) The next three characters represent the vertical location and help distinguish between samples taken from different depths at the same horizontal location. For nested well clusters, these characters will be A, B or C, with A representing the deepest well.

(v) The next two characters denote the event number, and usually reference the chronological event for a specific activity such as the number of rounds for groundwater sampling.

(vi) The last two characters represent the sample modifier in the case of duplicates and matrix spikes.

After an identification number has been assigned to each sample, pertinent information about each sample will be documented in the sample log sheet and field log book, including:

- Sample number;
- Date and time sample collected;
- Well and/or boring identification number;
- Depth of sample;
- Analysis to be performed;
- Sample description;
- pH, temperature, and specific conductivity (for groundwater samples only);
- Name of person collecting the sample; and
- Notes regarding unusual site conditions.

4.1.8 Waste Handling

Investigation-derived waste will be handled according to MMR IRP procedures which are described in Section 5.0 of this document (see MMR SOP 2-6, CDM, 1993).

4.1.9 Health and Safety Monitoring

A Health and Safety Plan (HASP) has been prepared (see Appendix B). The plan details the health and safety procedures to be followed during all field activities. Section 3.1.3 describes the UXO survey phase of the project. The UXO screening will include all sampling areas and access roads to these areas within the impact zone. These surveys will be performed by a qualified

UXO specialist following standard Army procedures in consultation with the explosive ordnance detachment.

4.1.10 Hydrogeologic Characterization

Aquifer testing will be performed on all permanent investigation wells completed as part of this project as described in Section 3.1.9. Slug tests (both rising and falling head tests) will be conducted on each investigation well following the procedures in MMR SOP 4-6 (CDM, 1993). These data will be analyzed using the appropriate methodologies.

After the completion of the slug testing program. Three sites will be chosen for long term pumping tests. Test locations and plans will be designed in consultation with the USGS ground water modeling experts and approved by the EPA to ensure that the data meets the needs of the ground water model. It is envisioned that the tests will last five days and include peizometers both above and the below the elevations where the investigation wells are screened to collect data on the vertical anisotropy of the aquifer.

4.1.11 Quality Control Samples

The types of Quality Control (QC) samples to be collected during the field work include trip and field blanks, equipment rinsate blanks and duplicates. These items are explained below.

4.1.11.1 Field and Trip Blanks

Field blanks are samples collected from the source of water used for drilling, decontamination and steam cleaning during the investigation. At least one field blank is collected from each source of water used for a given program. Normally, the same source of water is used for steam cleaning and decontamination, so only one field blank is collected. However, if different sources of water are used for these purposes, additional field blanks must be taken.

Trip blanks are 40-ml glass vial samples prepared by a laboratory, transported to the sampling site and returned to the laboratory with VOC samples. Trip blanks are used to detect

contamination by VOCs during sample shipping and handling. Trip blanks accompany and are stored and analyzed with VOC samples.

4.1.11.2 Equipment Rinsates

Equipment rinsate samples are collected by passing water through decontaminated sampling equipment. These samples are used to measure the effectiveness of the decontamination process. MMR SOP 2-2 recommends collecting one rinsate for each type of sampling equipment used each day decontamination is performed. If more than one type of equipment is used to obtain samples from a particular matrix, the rinsate blank must be collected in a manner to provide information on each piece of equipment. Equipment rinsates are analyzed for the same analytes as the samples collected.

4.1.11.3 Field Duplicates

Field duplicates are samples collected in duplicates from the same matrix. For each analyte, field duplicates will be collected immediately following the original sample. Duplicates will be collected at a frequency of 10 percent of the samples collected per matrix.

4.1.11.4 Matrix Spike/Matrix Duplicate samples

To check the laboratory Quality Control, matrix spike and matrix spike duplicate (MS/MSD) samples are collected. These samples will be prepared according to the Quality Assurance Project Plan (QAPP) (see Appendix A).

4.2 Analytical Program

Initially, 586 soil and sediment samples and 156 water samples will be collected for analysis (see Table 4-1). The soil samples will consist of 415 surface soil, 49 subsurface, and 20 sediment samples. Ninety-two quality assurance/quality control soil samples will be collected 46 duplicates and 46 MSD samples. Approximately 10 samples from investigation derived soil cuttings for TCLP analysis. A total of 156 water samples will be collected including 5 surface water samples, 67 ground water samples and 84 quality assurance/quality control samples

including 8 field and trip blanks, 40 equipment rinsates, 9 duplicate and MSD samples and 10 for TCLP analysis.

These samples will be analyzed for explosive compounds, TAL inorganics, TCL organic compounds including VOCs and SVOCs; TCL pesticides/PCBs and herbicides; EDB, and MTBE. The primary contaminants of concern for this investigation are those derived from the munitions used and their degradation byproducts. Therefore, the analytical program will consist of a laboratory analyses of 100 percent of the samples for TAL inorganics, which include the heavy metals found in munitions, 100 percent of the samples for explosives, and 30 percent of the samples for all other analytes. This percentage may be adjusted up or down based on the site characterization and consultation with the EPA. As the study progresses, additional sampling and analysis will be performed.

4.2.1 Field Screening

Soil and sediment samples will be subjected to field headspace screening for volatile organics using a Flame Ionization Detector (FID). Results of this screening will be used to determine worker protection and/or to identify samples for laboratory analysis.

4.2.2 Laboratory Analysis

Laboratory analysis will be conducted using EPA Contract Laboratory Program (CLP) methodologies, except where explosives are involved and no CLP method exists. In these cases, the analysis will be done by EPA used for similar investigations at MMR or other military installations.

Tables in the QAPP (Appendix A) summarize the analytes list, the Maximum Contaminant Levels (MCLs) and/or soil screening limits as stipulated by the MMR Risk Assessment Handbook and the method detection limits.

4.2.3 Data Management and Evaluation

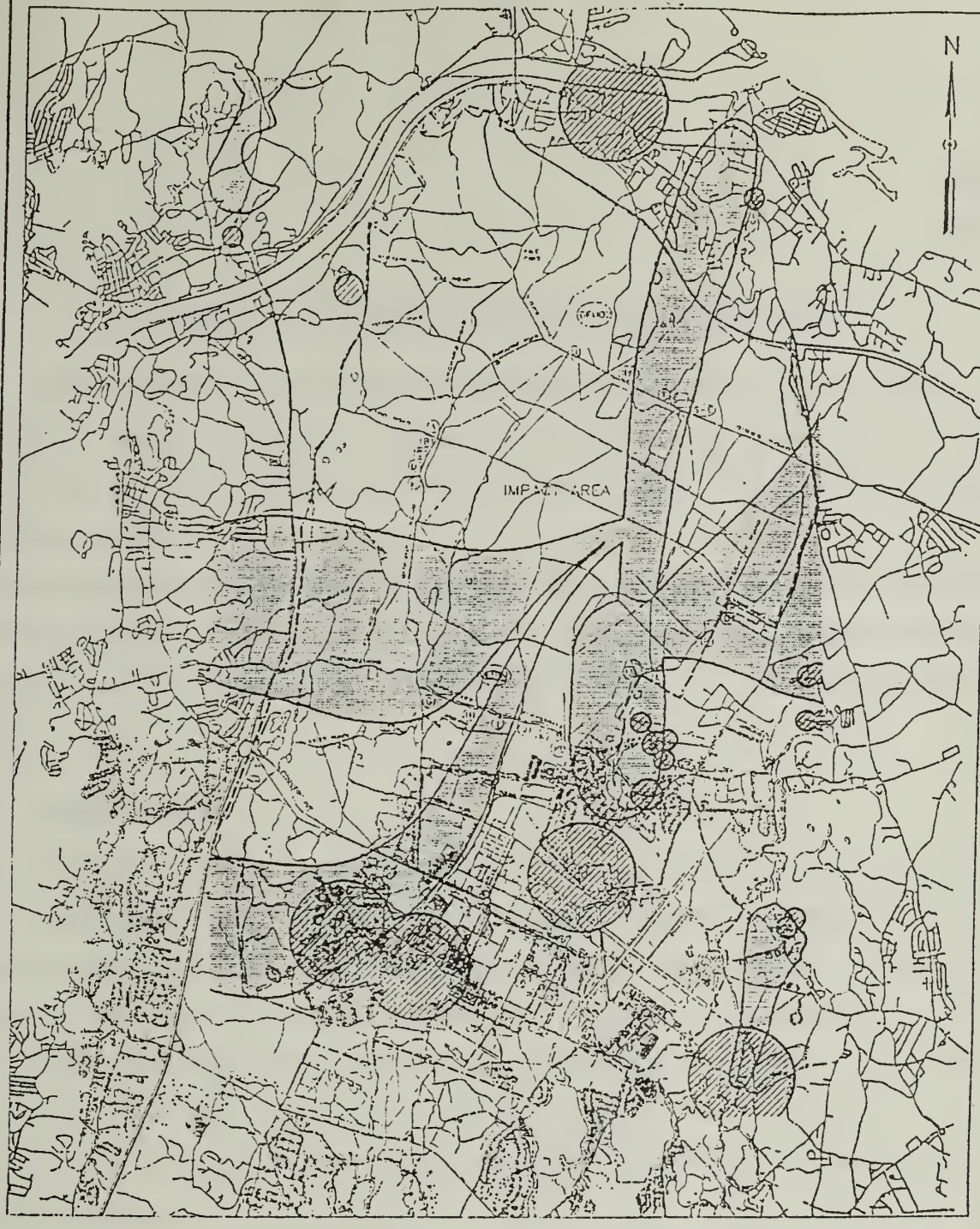
Analytical reports will be reviewed for sample collection, handling, analytical and reporting consistency. The project-specific Quality Assurance/Quality Control (QA/QC) plan is provided in Appendix A.

A systematic process to evaluate and validate the data for this project is outlined in the site-specific QA/QC plan. This data validation process will consist of the use of acceptable criteria to provide assurance that the data are adequate for their intended use. The process will involve data editing, screening, checking, auditing, verification, flagging, certification and review. The data review and validation will be conducted independent of the laboratory conducting the analyses.

4.2.4 Well Head Protection Area Review

There are several municipal water supply wells to the south of the training range and impact area (Bourne, Falmouth, and Sandwich). There are also water supply exploration efforts taking place around the training range and impact area. The zone of contribution to these wells will be examined and reviewed to determine if the training range and impact area falls within the limits of the Zone II well head protection areas of these municipal wells or the water supply test wells being drilled and tested in and around the range and impact areas. Figure 4-1shows the preliminary Zone II areas for the LRWSPAT test wells (Stone and Webster, 1996).

Massachusetts law requires water supply wells to delineate a well head protection area (WHPA). Municipalities are required to enact special zoning ordinances and take other measures to protect groundwater within the WHPA against contamination (MADEP Guidelines and Policies for Public Water Systems, 1991). Each water supply well permitted to pump more than 100,000 gallons per day is required by law to delineate Zone I, Zone II, and Zone III WHPAs. Zone I is the area within a 400-foot radius of the well. Zone II is the area that contributes water to the well under specific, permitted pumping and recharge conditions. Zone III is the watershed that contributes water to the well. The Zone II delineation prepared for the existing and potential municipal wells will be reviewed to verify if they fall within the training range and impact area.



NOTE:
ZONE II AREAS HAVE BEEN APPROXIMATED.
SOME ZONE II AND INTERIM WELLHEAD PROTECTION EXTREME BOUNDARIES HAVE NOT BEEN COMPLETELY DEFINED.

0 2000 4000 FEET
1" = 4000'

Source:
Camp Edwards Environmental Protection Office

LEGEND
INSTALLATION BOUNDARY
ZONE II
INTERIM WELLHEAD PROTECTION AREA

FIGURE 4-1

DRAWN _____ DATE
CHECKED _____ DATE
APPROVED _____ DATE

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS • PLANNERS • SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
(410) 461-2920 FAX (410) 461-2930

Zone II Wellhead Protection Areas

SCALE | CONTRACT NO.: | DATE | SHEET

5.0 DECONTAMINATION AND WASTE DISPOSAL

All equipment and tools will be cleaned before beginning the field work and during well installation and sample collection. All personnel will be protected as outlined in the Health and Safety Plan. This work will generate investigation derived wastes (IDW) that will need proper handling and disposal.

These investigation derived wastes will include drill cuttings from well installation, waste liquids from decontamination activities, well development and purge waters, unused sample bottles and used protective clothing and equipment. These wastes will be handled according to the following protocol.

5.1 Decontamination

The drilling contractor will provide an acceptable rig and support truck equipped with a steam cleaner, water tank, portable wash rack, and other equipment necessary to complete the drilling and well installation program. A decontamination pad for the heavier equipment (such as rigs, augers and rods) and a staging area for supplies will be constructed at a location approved by the MMR Range Management Office. All drill rigs, construction equipment and tools will be cleaned before beginning the field program. All decontamination will take place at the decontamination pad except for reusable sampling equipment, which may be decontaminated at the drilling location.

Decontamination procedures will follow the SOP for environmental investigations at MMR (CDM, 1993) Cleaning of heavy equipment will consist of scraping, brushing, washing with potable water and steam cleaning until exposed surfaces are free of soil residue. Augers and wrenches will be rinsed with distilled water, and air dried. Pumps used for circulating water and sampling will be decontaminated by circulating an Alconox/water solution in the pump and submersible lines, followed by a distilled water rinse.

Reusable sampling equipment will be decontaminated according to the following procedure:

- Remove visible contamination by brushing or wiping with a cloth;
- Wash and scrub with an Alconox/water solution;
- Rinse with potable water;
- Rinse with nitric acid;
- Rinse with distilled water;
- Rinse with methanol and hexane; and
- Air dry and wrap equipment in aluminum foil.

Reusable protective clothing and equipment (such as gloves, boots and hard hats) will be decontaminated as follows:

- Wash with an Alconox/water solution
  Rinse with potable water;
- Rinse with distilled water; and
- Air dry and store in a polyethylene bag to prevent contamination during storage or transport.

5.2 Waste Disposal

The investigation and decontamination process will generate contaminated wastes that require proper handling and disposal. The following is an outline of the appropriate handling procedures for each of these waste streams.

5.2.1 Personal Protective Equipment (PPE)

All used PPE will be segregated based on the judgment of the field supervisor as to whether they are hazardous waste or trash. PPE contaminated with hazardous waste will be drummed and

stored at the central staging area for proper disposal. PPE not contaminated by hazardous waste will be disposed of as general trash.

5.2.2 Soil

The soil boring and investigation well installation programs will generate soil cuttings. Samples of the soils will be screened for volatile organic compounds by an FID instrument, using the headspace screening method. All soil cuttings will be drummed in a plastic-lined, DOT-approved, open-end sealed 55-gallon steel drum. Recycled drums may be used; however, the liner must be new and water tight. For tracking, all drums will be labeled with an identification number, the place of origin (soil boring or well designation) and content. Materials from different borings will not be combined in the same drum, nor will solid and liquid wastes be placed in the same drum.

All drums containing investigation derived soil cuttings will be transported to the central staging area. Disposition will be the responsibility of the Massachusetts Army National Guard (MAARNG).

5.2.3 Water

All investigation derived waste waters will be segregated into 55-gallon drums by source. Well development and purge waters will be stored separately for each well. Water used for decontamination also will be stored separately. All drummed water will be staged on site until proper sampling and analysis. Samples of this water will be collected at a frequency of one sample per 1,000 gallons and tested for hazardous parameters. If the results of this analysis indicate it is nonhazardous, the water will be filtered through activated carbon and discharged to the surface. If the results indicate the water is hazardous waste, it will be transported to the staging area for proper disposal.

The drilling contractor will be responsible for all transport and staging of the waste, as well as building and dismantling of the decontamination pad. Once staged and properly labeled, the disposal of all investigation derived wastes will be the responsibility of the MAARNG.

6.0 SITE-SPECIFIC QUALITY CONTROL AND HEALTH AND SAFETY PLAN

The field work for this project will be conducted within the guidelines of the MMR Standard Operating Procedures (SOP), Quality Assurance/Quality Control (QA/QC) and the general Health and Safety Plan (HASP). However, these generic plans will be amended through addenda to address site and project specific requirements. Only the addenda are discussed and provided as appendices to this work plan. The original documents are made part of this document by reference.

6.1 Quality Assurance Project Plan

Appendix A is a detailed, project-specific QA/QC plan, which will be an addendum to the original document. It details the QA/QC measures that will ensure that the data quality objectives of this project are met. A systematic data validation process will ensure the data are adequate for their intended application and use.

6.2 Health and Safety Plan

A site-specific health and safety plan is provided in Appendix B. All personnel who work in the field will be required to have completed the 40 hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Investigation Training and have current certification. In addition, a baseline and exposure history will be maintained for all personnel through a medical surveillance program. The health and safety officer will maintain and document such records. The anticipated level of worker protection is Level D, but all field personnel will be prepared to upgrade to a modified Level D or Level C. For that purpose, sufficient safety equipment will be maintained on site for all personnel to provide for appropriate

protection as determined by the on-site health and safety officer. At a minimum, the following safety equipment must be available for all personnel on site:

- Safety goggles;
- Hard hats;
- Chemical resistant/Tyvek coveralls;
- Steel-toed work boots;
- Disposable rubber gloves;
- Full-face air purifying respirators; and
- Adequate supplies of GMC-H APR cartridges.

The field supervisor or his designate will conduct a daily safety meeting for each field activity. The supervisor also will be responsible for instituting the necessary supplemental safety procedures.

7.0 PROJECT MANAGEMENT AND SCHEDULE

7.1 Project Management

Figure 7-1 is a chart showing the organizational structure for this project. This project is being conducted under an administrative order from EPA Region I. Therefore, the scope of work and schedule have been developed in consultation with the EPA, who will also feature prominently in the management and approval of the fieldwork and any changes thereto. A brief description of the responsibilities of each entity and key personnel is provided below.

7.1.1 Organizational Structure

The overall responsibility for the program rests with the National Guard Bureau through the interim Project coordinator, Gerard Winters. His responsibility will be to monitor the progress of the program, review and approve all work products and deliverables, monitoring the financial and schedule control, and instituting corrective action, if necessary.

The counterpart is the EPA technical project manager. He/she will be responsible for ensuring that the quality and schedule of the work meets the requirements of the administrative order; and will also be responsible for controlling the release of information to the public and special interest groups. The EPA project coordinator will also work with the NGB project coordinator and other regulatory agencies to ensure that their needs and opinion are reflected in the conduct of the program.

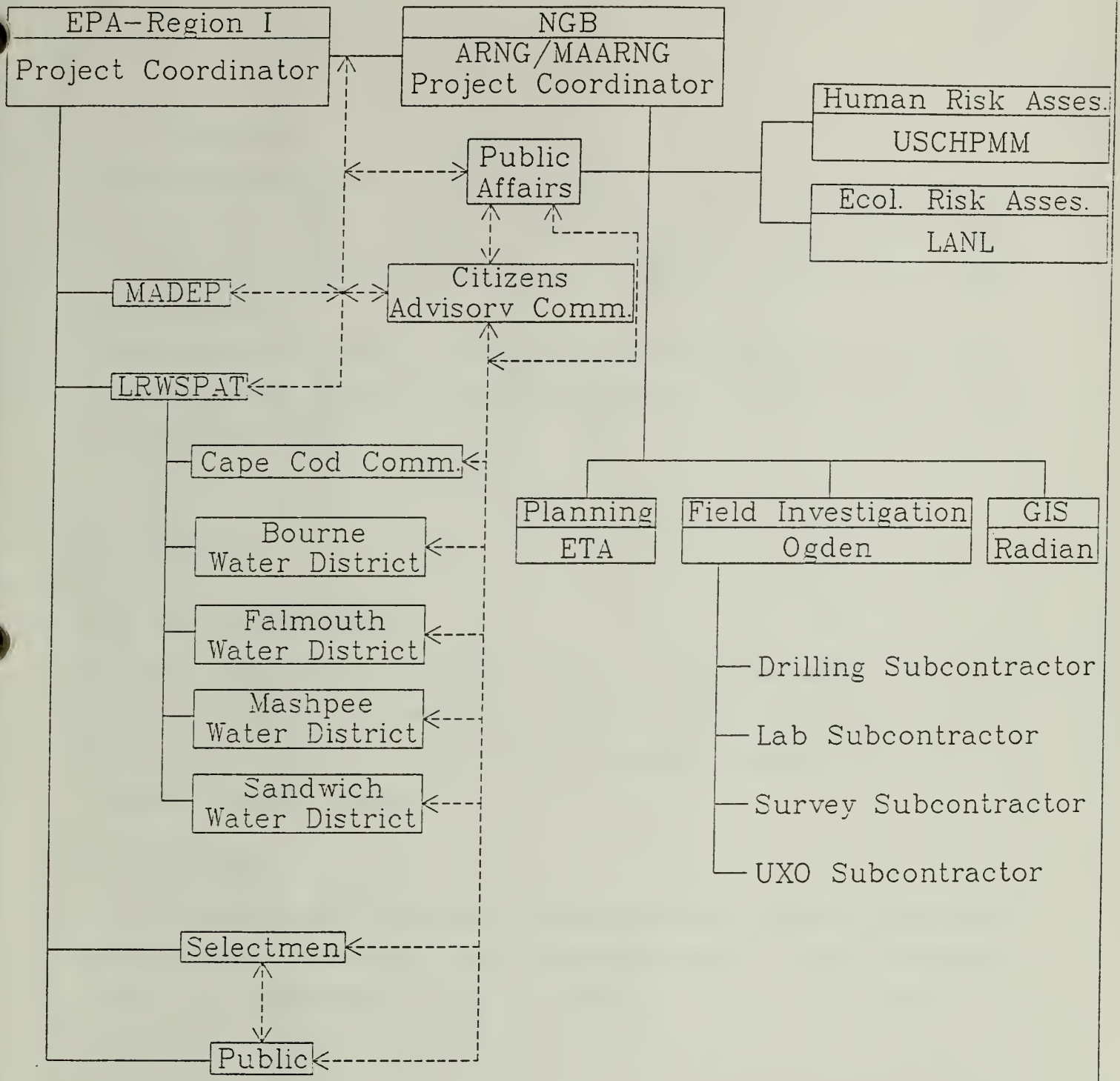
The primary consultant to the NGB for completion of this program will be Ogden Environmental and Energy Systems (OGDEN). They will be responsible for supervising the fieldwork and

documenting the data and information collected to ensure the technical integrity of the study. By contract, OGDEN will supervise several subcontractors who will provide specialty expertise to various tasks of the program. The OGDEN project Manager will be Mr. Marc Grant. Mr. Grant will work directly with the NGB project coordinator, and will be responsible for project staffing and direct management of all staff and subcontractor assignments to the project. In this role, the OGDEN project manager will be responsible for ensuring that the NGB and EPA project coordinators are kept informed of the technical and schedule progress of the project.

To assist the project manager, the following task and activity managers may be selected:

Planning and technical oversight coordinator;
Field activities and task Manager;
Lead chemist;
Sample tracking and data management coordinator
Health and Safety Officer;
Quality Assurance Officer;
Technical Reviewer; and
Program Administrator.

These assistants to the project Manager will be assigned responsibilities for coordinating all activities required to achieve the stated goals of the their task assignment.



ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS • PLANNERS • SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9929 WASH. 921-4690

Figure 7–1
Organizational Chart

SCALE:	CONTRACT NO.:	DATE:	SHEET:

7.1.2 Subcontractors

OGDEN will subcontract with some specialty services providers to facilitate the completion of this program. In putting the team together, OGDEN selected team members to provide enough flexibility, technical know-how and experience with the specifics of the project to ensure quality service to the study.

Particular attention was paid to the specialty functions of the program, so that the selected team members have proven experience and strong staff capabilities in the specialty areas of the project for which they were chosen.

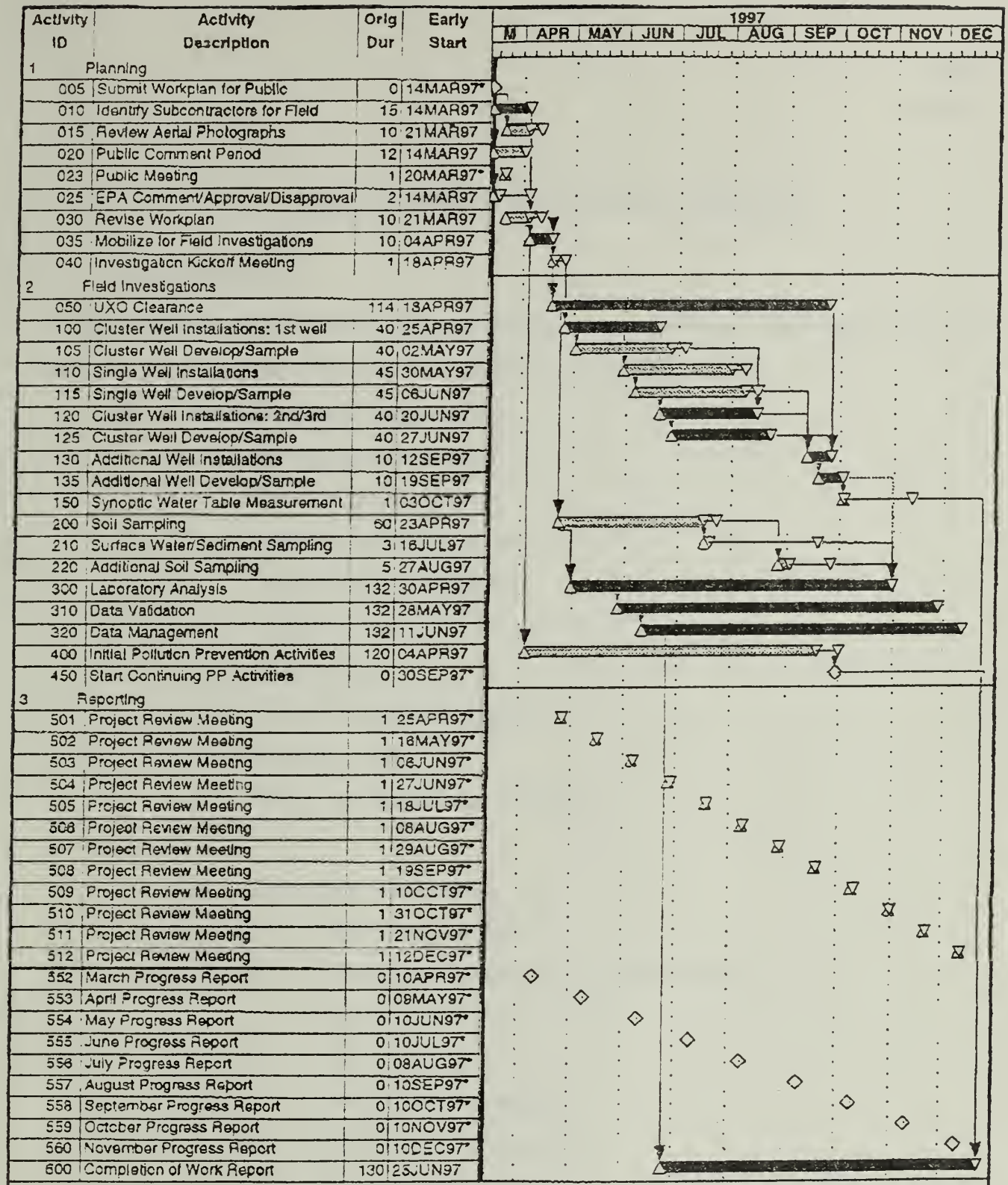
7.2 Schedule

7.2.1 Overall Project Schedule

The overall project schedule is shown in Figure 7-2. The proposed project schedule was developed according to the requirements of the administrative order, and in consultation with the EPA. Any scheduling problems will be resolved at the project coordination level between the NGB and EPA project coordinators.

7.2.1 Deliverables

The only project deliverable will be the site characterization report. OGDEN will prepare and submit this report as a draft report, a draft final and final report. The report will include a summary of the methodologies and activities conducted, a summary of the results of the literature search and review, and an evaluation and interpretation of the data collected. The conclusions drawn from the study and the inferences made from the data will be included; and recommendations made as to the follow on investigation, if necessary.



Activity ID	Activity Description	Orig Dur	Early Start
1	Planning		
005	Submit Workplan for Public	0	14MAR97*
010	Identify Subcontractors for Field	15	14MAR97
015	Review Aerial Photographs	10	21MAR97
020	Public Comment Period	12	14MAR97
023	Public Meeting	1	20MAR97*
025	EPA Comment/Approval/Disapproval	2	14MAR97
030	Revise Workplan	10	21MAR97
035	Mobilize for Field Investigations	10	04APR97
040	Investigation Kickoff Meeting	1	18APR97
2	Field Investigations		
050	UXO Clearance	114	18APR97
100	Cluster Well Installations: 1st well	40	25APR97
105	Cluster Well Develop/Sample	40	02MAY97
110	Single Well Installations	45	30MAY97
115	Single Well Develop/Sample	45	06JUN97
120	Cluster Well Installations: 2nd/3rd	40	20JUN97
125	Cluster Well Develop/Sample	40	27JUN97
130	Additional Well Installations	10	12SEP97
135	Additional Well Develop/Sample	10	19SEP97
150	Synoptic Water Table Measurement	1	03OCT97
200	Soil Sampling	60	23APR97
210	Surface Water/Sediment Sampling	3	16JUL97
220	Additional Soil Sampling	5	27AUG97
300	Laboratory Analysis	132	30APR97
310	Data Validation	132	28MAY97
320	Data Management	132	11JUN97
400	Initial Pollution Prevention Activities	120	04APR97
450	Start Continuing PP Activities	0	30SEP97*
3	Reporting		
501	Project Review Meeting	1	25APR97*
502	Project Review Meeting	1	16MAY97*
503	Project Review Meeting	1	06JUN97*
504	Project Review Meeting	1	27JUN97*
505	Project Review Meeting	1	18JUL97*
506	Project Review Meeting	1	08AUG97*
507	Project Review Meeting	1	29AUG97*
508	Project Review Meeting	1	19SEP97*
509	Project Review Meeting	1	10OCT97*
510	Project Review Meeting	1	31OCT97*
511	Project Review Meeting	1	21NOV97*
512	Project Review Meeting	1	12DEC97*
552	March Progress Report	0	10APR97*
553	April Progress Report	0	08MAY97*
554	May Progress Report	0	10JUN97*
555	June Progress Report	0	10JUL97*
556	July Progress Report	0	08AUG97*
557	August Progress Report	0	10SEP97*
558	September Progress Report	0	10OCT97*
559	October Progress Report	0	10NOV97*
560	November Progress Report	0	10DEC97*
600	Completion of Work Report	130	23JUN97

Figure 7-2
Proposed Schedule

8.0 RECORD KEEPING AND REPORTING

8.1 Record Keeping

All field activities will be recorded in bound notebooks with sequentially numbered pages. At a minimum, the following information will be entered in the field notebooks:

(i) Surface/Sediment Sampling Data

- Sample location designations
- Depth of sample location
- Visual classification of soils
- Date and time of collection
- Type of container
- FID reading
- Date of shipment to laboratory
- Sampler's name
- Notes regarding unusual conditions

(ii) Subsurface Soil Sampling

- Soil boring designation
- Visual classification of soils (unified system)
- Depth to groundwater
- Date of boring
- Interval/depth of sample
- Date and time of collection
- Field weather conditions
- Analysis required

- Date of shipment to laboratory
- Sampling method
- Sampler's name
- Notes regarding unusual conditions

(iii) Groundwater Investigation well data

- Investigation well designation
- Surface coordinates, top of casing elevation, depth of borehole and depth of well
- Visual soil classification
- Depth to groundwater
- Date of installation
- Boring and well completion logs
- Well development logs
- Field weather conditions
- Notes regarding unusual conditions

(iv) Groundwater Level Measurements

- Well designation
- Date and time of measurement
- Well depth
- Static water elevation
- Type of measuring equipment used
- Technician's name
- Notes regarding unusual conditions

(v) Groundwater Sample Data

- Well designation
- Well depth and static water level
- Well volume and required purge volume
- Type of container and preservatives
- Types and makes of sampling equipment
- Monitoring equipment readings
- Date and time of collection
- Analysis required
- Date of shipment to laboratory
- Sampler's name
- Notes regarding unusual conditions

All entries in the field notebook and the field logs will be made in indelible black ink. Corrections will be made by drawing a single line through the error and initialing and dating the correction. Individuals making entries will sign and date the bottom of each page of the notebook. All field log books will be legible.

8.2 Reporting

Upon completion of sample collection and analysis, the results of field observations and laboratory analysis will be summarized in a draft report. This report will consist of a summary of the data, field procedures used and the inferences drawn from the data to identify probable sources, and current status of groundwater quality. It will also recommend the next step for characterization of the site.

The following is a report outline:

Table of Contents

List of Figures

List of Tables

List of Appendices

List of Abbreviations and Acronyms

Executive Summary

1.0 Introduction
- 1.1 Purpose
- 1.2 Physical Setting
- 1.3 Report Organization

2.0 Background
- 2.1 Site Location and History
- 2.2 Site Description

2.2.1 Physiography

2.2.2 Geology and Hydrogeology

2.2.3 Literature Review

3.0 Field Program and Procedures
- 3.1 Soil/Sediment Sampling
- 3.2 Soil Boring and Well Installation
- 3.3 Location/Elevation Survey
- 3.4 Groundwater Elevation Measurements
- 3.5 Subsurface Soil Sampling
- 3.6 Groundwater Sampling
- 3.7 Quality Assurance/Quality Control

3.7.1 Field Program Documentation

3.7.2 Field Quality Control Procedures
3.7.3 Audits
4.0 Data Review and Analytical Results
4.1 Results of Literature Review
4.2 Soil/Sediment Analytical Results
4.3 Groundwater Analytical Results
4.4 Analytical Data Quality
4.4.1 Laboratory Performance
4.4.2 Data Evaluation
5.0 Risk Assessment
6.0 Conclusions and Recommendations
7.0 References

9.0 REFERENCES

1. CDM, Standard Operating Procedures for Work to be Performed at MMR, September 1993.

2. ABB Environmental Services, Inc., "Site Assessment, Work Completion Report-Chemical Spill Site in Impact Area, Massachusetts Military Reservation, Cape Cod," November 1992.

3. USAEHA, HSHB-ME-SH, "Interim Report, Hazardous Waste Study No. 37-26-0165-87, Investigation of Soil Contamination from Propellant Burns, Camp Edwards, Massachusetts, 25-29 June and 14-15 July, 1987," September 1987.

4. USAEHA, "Site Inspection Workplan, Geophysical Study No. 38- 26-K33U-95, Sites CS-18 and CS-19, Massachusetts Military Reservation, Cape Cod, Massachusetts," June 1994.

5. USACHPPM, "Draft Final Site Inspection, Geophysical Study No. 38-26-0278-95, Propellant Burning at Firing Points (CS- 18), Massachusetts Military Reservation, Cape Cod, Massachusetts," June 1996.

6. ERI, "Aerial Photographic Site Analysis, Massachusetts Military Reservation Impact Area, Barnstable County, Massachusetts," March 1994.

7. USACHPPM, "Draft Final Site Inspection Report No. 38-26- 1339-95, Site CS-19, Massachusetts Military Reservation, Cape Cod, Massachusetts," June 1996.

8. IRP, "Risk Assessment Handbook, Massachusetts Military Reservation, Cape Cod, Massachusetts," September 1994.

9. Letter, USAEHA, HSHB-ES-H, "Groundwater Monitoring Study No. 38-26-0457-86, AMC Open Burning/Open Detonation Facilities," October 1985.

10. Schuh, W. M., "Planning, Construction, and Initial Sampling Results for a Water Quality Monitoring Program: Camp Grafton South Military Reservation, Eddy County, North Dakota," North Dakota Water Resource Investigation No. 27, 1994.

11. Metcalf & Eddy, Inc., "Installation Restoration Program: Phase I Record Search," Otis Air National Guard Base, Massachusetts, 1983.

12. Bricka, R. M., "Draft Report for Review, Investigation of the Vertical Migration Potential of Metal Contaminants at Small Arms Firing Ranges at Camp Edwards Military Reservation," March 1996.

13. U.S. Environmental Protection Agency (USEPA), July 1996, Soil Screening Guidance: User's Guide, Office of Solid Waste and Emergency Response, Publication 9355.4-23.

14. U.S. Environmental Protection Agency (USEPA), January 1996, "Ecotox Thresholds," ECO Update, Office of Solid Waste and Emergency Response, Publication 9345.0-12FS.

15. McGrath, October 1996, updated version of Physical, Chemical, and Environmental Data for Common, Explosive- Associated Compounds (XACs) tables.

16. Townsend and Meyers, 1996, Recent Developments in Formulating Model Descriptors for Subsurface Transformation and Sorption of TNT, RDX, and HMX, Technical Report IRRP-96- 1, U.S. Army Corps of Engineers Waterways Experiment Station.

17. Gunnison, Pennington, Price and Myrick, 1993, Screening Test and Isolation Procedure for TNT-Degrading Microorganisms, Technical Report IRRP-93-2, U.S. Army Corps of Engineers Waterways Experiment Station.

18. Honeycutt, Jarvis, and McFarland, 1996, "Cytotoxicity and Mutagenicity of 2,4,6-Trinitrotoluene and Its Metabolites", Ecotoxicology and Environmental Safety, Vol 35, pp. 282-287.

19. Pennington and Patrick, 1990, "Adsorption and Desorption of 2,4,6-Trinitrotoluene by Soils", Journal of Environmental Quality, Vol. 19, No. 3, pp. 559-567.

20. Jacobs Engineering Group, 1997, Massachusetts Military Reservation Inorganics Investigation Technical Memorandum, draft, Document # AFC-J- 23-35K78411-M17-001, prepared for HQ AFCEE/MMR.

DRAFT

ACTION PLAN FOR THE CAMP EDWARDS IMPACT AREA GROUNDWATER QUALITY STUDY

APPENDIX A QUALITY ASSURANCE / QUALITY CONTROL PLAN

MASSACHUSETTS MILITARY RESERVATION
CAPE COD, MASSACHUSETTS

Prepared for

NATIONAL GUARD BUREAU
ARLINGTON, VIRGINIA

Prepared by

OGDEN ENVIRONMENTAL AND ENERGY SERVICES

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.

March 1997

1.0 PROJECT DESCRIPTION

1.1 Introduction

The Massachusetts Military Reservation (MMR) is located on upper Cape Cod, about 60 miles south east of Boston. Approximately 14,000 acres of this 22,000 acre facility, refered to as the range, maneuver and impact area, has been, and is still used for military and law enforcement training. The range and impact areas are being considered for the development of municial water supplies. This investigation of the range and impact areas is designed to determine if there is any ground water quality impairment resulting from the training activities in the areas.

This Quality Assurance/Quality Control (QA/QC) plan serves as a controlling mechanism during the investigation to ensure that all data collected are valid, reliable and defensible. This document outlines the objectives, organization, and QA/QC activities to be undertaken in order to achieve the desired goals. This QA/QC plan is being prepared as an addendum to the generic QA/QC plan for conducting environmental investigations at MMR, and according to the Environmental Protection Agency's (EPA) guidelines and specifications for preparing quality assurance plans, EPA-600/483-004.

1.2 Site Description and History

The range and impact areas occupy about 14,000 acres in the north-central portion of MMR. This facility consists of a centrally located impact area used for heavy mortar and artillery training; and numerous firing ranges, gun and mortar positions and training areas surrounding the impact area.

For over 40 years, the range and impact area has been used for firing of small arms, guns, heavy artillery, and ordnance demolition. The spent shells and byproducts of the used munitions can cause environmental impairment, and subsequently result in environmental degradation of the soils and groundwater.

1.3 Target Compounds

Previous investigations have detected low levels of some pesticides, explosives and heavy metals in the soils. Table 1-1 shows a list of contaminants detected at the site by previous investigations, and how their levels compare with EPA risk-based screening concentration for industrial soils (EPA Screening Guidance, July 1996). For some of the heavy metals, risk-based screening levels were slightly exceeded. The lead levels are also higher than the 400mg/kg suggested by EPA.

1.4 Project Objectives

The objectives of the field program are to obtain the data and information to evaluate the quality of ground water beneath the range and impact areas. To obtain the necessary data, a sampling program to collect and analyze samples from various environmental media is being proposed.

Upon completion of the field program, the data obtained will be used to support a preliminary risk evaluation, and also to determine whether additional investigations are warranted.

1.5 Data Quality Objectives

Samples collected will be analyzed for Explosive Compounds (Explosives), Target Compound List Volatile Organics (TCL VOCs), TCL Semivolatiles (TCL SVOCs), TCL Pesticides and PCBs (Pesticides/PCBs), and Target Analyte List Inorganics (TCL Metals/CN) using CLP methods where available, and for explosives using Test Methods for Evaluating Solid Waste, SW-846 Method 8330. Data will be

TABLE 1-1. List of Suspected Contaminants

Parameter	Maximum Amount Detected mg/kg	EPA Generic Soil Screening Levels *1* mg/kg .	OSHA PEL/ ACGIH TLVs mg/m^3
hexachlorabenzene	.6	2	NE / 0.025 skin, Ca
diethylphthalate	14	470	5.0 / 5.0
N-Nitrosodiphenylamine	0.38	1	NE / NE
2,4-DNT	0.71	0.0008	1.5 skin / 0.15 skin
PESTICIDES			
DDE	0.005	54	1.0 ca / 1.0 Ca
DDD	0.130	16	1.0 ca / 1.0 Ca
endrin ketone	0.0360	1	0.1 skin / 0.1 skin
endosulfan sulfate	0.009	18	0.1 skin / 0.1 skin
alpha chlordane	0.009	10	0.5 skin / 0.5 skin, Ca
gamma chlordane	0.010	10	0.5 skin / 0.5 skin, Ca
EXPLOSIVES			
HMX	2.713		NE / NE
TNT			1.5 skin / 0.5 skin
RDX			
	0.009	100(furan)	NE / NE
Dioxins and Furans			
HERBICIDES	0.029		NE / NE
dinoseb	232		NE / NE
MCPP			
INORGANICS	26100		15 / 10
aluminum	30.8	38	1.0 / 0.5
chromium (total)	156		1.0 / 1.0
copper	22700		5 / 5
iron	1830	400	0.05 / 0.05 Ca
lead	12200		15 / 10
magnesium	188		5 cel / 0.2
manganese	0.36	2	0.1 cel / 0.01
mercury	22.9	6000	0.5 cel / 0.05
vanadium	15.7	130	0.015 /0.1
nickel	4.7	29	0.5 / 0.01 Ca
arsenic	26000	1600	0.5 / 0.5
barium	1.2	63	0.005 Ca /0.002 Ca
beryllium	4.5	8	0.005 Ca /0.002 Ca
cadmium	1480		5.0 / 2.0
calcium	1200		NE / NE
potassium	5.9	34	0.01 / 0.01
silver	180	12000	15 / 10
zinc			

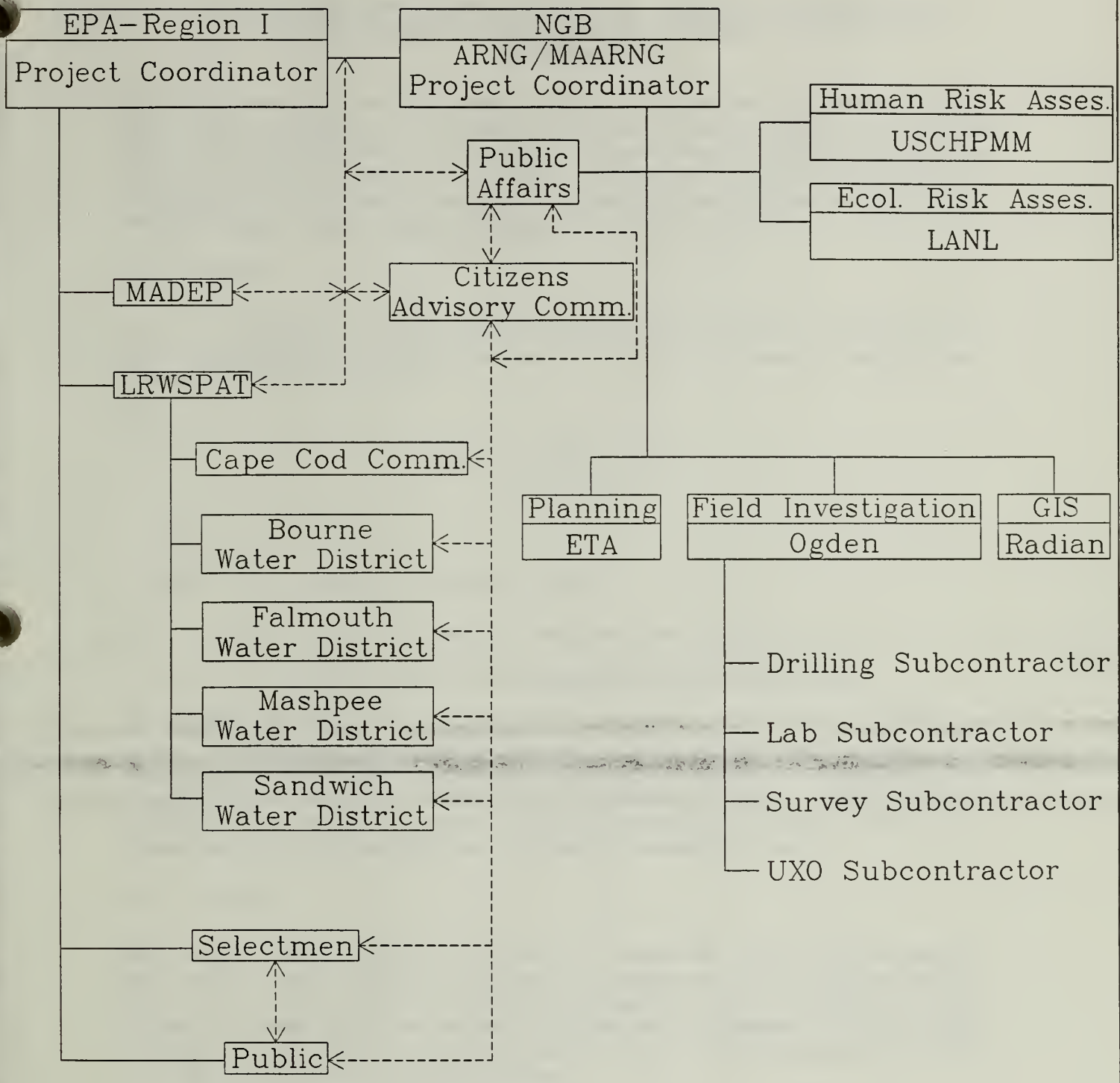
1. From EPA, July 1996, Soil Screening Guidance Technical Background Document Appendix A.
Skin = prevent skin contact.
Ca = Carcinogen.
Cel = Ceiling level
NE = None established

independently validated according to the USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, (USEPA, Feb. 1994) and the USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, (USEPA, Feb. 1994). If any EDB analyses are conducted, the data will be validated at the tier II level based on EPA guidelines.

Record keeping, field activities, sampling, sample custody, laboratory analyses, data reduction and validation must be of sufficient scope and detail that the resulting data are technically and legally defensible. This QA/QC plan prepared to outline the specific requirements for conducting all activities on this project to ensure that those objectives are met.

2.0 PROJECT ORGANIZATION

The Camp Edwards Impact Area Groundwater Quality Study is being performed in accordance with an Administrative Order issued to the National Guard Bureau (NGB) by USEPA Region I under the Safe Drinking Water Act. The NGB Project Coordinator will administer all actions under the terms of this Order, in coordination with USEPA's Technical Project Coordinator. A chart showing the relationship between NGB, USEPA, and other entities is provided in Figure 2-1. NGB subcontractors for the field investigation activities will be selected as indicated in the project schedule contained in the Workplan.



ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS • PLANNERS • SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-0920 WASH. 621-4690

Figure 2–1
Project Organization Chart

SCALE:	CONTRACT NO.:	DATE:	SHEET:

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS, REPRESENTATIVENESS, AND COMPARABILITY

The quality assurance objective for all measurement data include considerations for precision, accuracy, completeness, representativeness, and comparability. This section incorporates, by reference, portions of the USEPA Contract Laboratory Program (CLP) protocols. For organic parameters, the protocols are found in the Statement of Work (SOW) OLMO3.2. For inorganic parameters, the protocols are found in the Statement of Work (SOW) ILMO4.0. Furthermore, parts of this section also incorporate by reference portions of the EPA 600 Series Methods of Chemical Analysis of Water and Wastes, revised March 1993.

3.1 Precision

Precision is a quantitative measure of the variability between two duplicate samples. Precision is expressed as the relative percent difference (RPD) in concentration between duplicate and original sample analyses, as calculated from the following formula:

$$RPD = \frac{|S - D|}{\frac{1}{2}(S + D)} \times 100$$

where:

RPD = Relative percent difference (percent);

S = Concentration of analyte in first (original) sample (mg/kg or µg/l); and

D = Concentration of analyte in second (duplicate) sample (mg/kg or µg/l).

The precision of the analytical data is evaluated by calculating RPD values for four types of duplicate samples: field duplicates, MSDs, laboratory duplicates, and blank spike duplicates. For each type of duplicate sample, all RPD values for a given analyte are averaged to produce a single, analyte-specific average RPD value which is then compared against an established QC criterion. The QC criterion are method or laboratory specifec QC criterion. Data qualifiers may be applied in the data validation process to certain analytical results where RPD values do not meet the established QC criteria.

3.2 Accuracy

Spike sample analyses are conducted by the laboratory to assess the accuracy of specific analytical methods and to provide information on the effect of the sample matrix on the analytical methodology. Spike sample analyses are performed by adding known amounts ("spikes") of representative target compounds to a sample aliquot that is subjected to the entire analytical procedure. The original sample (non-fortified) and the spike sample results are compared. Accuracy is reported as percent recovery (%R) of the spike, as calculated from the following equation:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

%R = Percent recovery (percent);

SSR = Spike sample result (concentration units);

SR = Original sample result (concentration units); and

SA = Spike added (concentration units).

The accuracy of the analytical data is evaluated by calculating %R values for two types of spike samples: MS samples and blank spike samples. For each type of spike sample, all %R values for a given analyte are averaged to produce a single, analyte-specific average %R value which is then compared against an established QC criterion. QC criterion may be method or laboratory specific QC criterion. Data qualifiers may be applied in the data validation process to certain analytical results where the %R values do not meet the established QC criteria.

3.3 Representativeness

Representativeness expresses the extent to which the analytical data reflect the actual media at the site. In general, the data are representative of the site conditions and characteristics. Acceptable representativeness is achieved by proper sampling and sample management procedures as documented in Section 4.0 Representativeness will be evaluated with respect to general sample management issues including sample documentation, preservation, handling, and transport as well as a discussion of representativeness with respect to analytical-method specific issues including method deviations, presence of potential laboratory or field artifacts, indications of sample nonhomogeneity, internal standard recovery deficiencies, and surrogate recovery deficiencies.

3.4 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability of the sampling and analytical programs are evaluated separately.

Sampling comparability will be evaluated based upon the following:

- A consistent approach to sampling was applied throughout the program;
- Samples were consistently preserved; and
- Sampling was performed during the same time of the year and under similar physical conditions.

Analytical comparability will be evaluated based upon the following:

- The investigation consistently utilized the same analytical laboratory, sample preparation routine, and analytical methods;
- The analytical results for a given analysis were reported with consistent detection limits and consistent units of measure; and
- Soil sample results were reported on a dry weight basis, allowing for comparison between different samples and with Soil Screening Levels (SSLs).

3.5 Completeness

Completeness is a measure of the amount of usable data resulting from the sampling and analysis program. Completeness of the sampling and analytical programs are evaluated separately.

Sampling completeness is generally defined as the number of samples collected divided by the number of samples required to adequately assess Site conditions. The sampling completeness objectives are 90 percent.

Analytical completeness is defined as the percentage of acceptable (i.e., not rejected) data points. Analytical completeness is calculated on a method basis with the exception of Method ILM04.0 (metals); for this method, analytical completeness is calculated on an individual analyte basis. The completeness objective for the analytical program is 90 percent.

4.0 SAMPLING PROCEDURES

Sampling procedures have been developed to collect representative data and to guide future remediation. Sample collection locations and methods are detailed in Section 4.0 of the Workplan; and the appropriate Standard Operating Procedures (SOPs), presented in the "Standard Operating Procedures for work to be Performed at MMR" (CDM, 1993), and are incorporated herein by reference. The sample numbering system is described in Section 4.1.7 of the Workplan. All decontamination procedures, well development, purging, sample collection, and sample preservation will be conducted in accordance with this Quality Assurance/ Quality Control Plan. The numbers and locations of samples in the data collection program are summarized in Table 4-1.

4.1 Decontamination Procedures

To prevent contamination of samples by materials originating from on-site conditions, all sampling equipment will be decontaminated. Decontamination of large equipment such as drill rigs and pipe will consist of the following basic steps.

- Clean with high-pressure steam cleaner.
- Rinse with potable water.

The drilling rig, casing and screen, and all downhole equipment will be steam cleaned prior to entering the site and will be decontaminated in accordance with the above procedures prior to start of work. Before each use for monitoring well installation, the drill tools and equipment will be decontaminated as described above. The drill rig and platform will be decontaminated before entering each site or as needed as determined by the supervising geologist.

Sampling equipment coming in direct contact with samples will receive additional cleaning. The procedures to be used depend on the analyses to be conducted on the sample and are outlined in Section 5.1 of the Workplan.

4.2 Surface Soil Sampling

Surface soil samples (0-2 feet deep) will be collected using stainless steel trowels, bowls, spoons, and scoopulas. Each piece of sampling equipment will be decontaminated and wrapped in aluminum foil prior to use. The aluminum foil is to be removed prior to sample collection. Before actual collection of the sample, approximately the top 1 inch of soil will be removed from the sample location using the stainless steel trowel.

Sample volume required for VOC analyses will be collected and placed directly into the appropriate containers using the stainless steel scoopula. Once the sample bottles for VOC analyses have been filled, they will be labeled and placed into coolers packed with ice. Sufficient volume of soil for the remaining analytical fractions will then be obtained and placed in a stainless steel bowl. The soil will then be homogenized and placed into the appropriate sample bottles. The sample bottles will then be labeled and placed in coolers until the end of the day when they will be sent to the off-site laboratory via courier or overnight delivery.

4.3 Headspace Screening

All soil samples collected during this investigation will be subjected to headspace screening. This will be done by filling half of a 4-oz. glass jar with portions of the sample. The jar will be covered with aluminum foil and a lid, and allowed to equilibrate at room temperature (70o F) for approximately 15 minutes. This will allow any volatile organics in the sample to equilibrate within the air in the headspace above the sample. The probe of a Photo Ionization Detector (PID) will then be inserted through the aluminum foil into the headspace. The reading registered on the PID will be recorded.

TABLE 4-1 SAMPLE TYPES, NUMBER AND ANALYSIS

SOIL/SEDIMENT SAMPLES	Number of Samples	Explosive	TAL Metals	TCL Volatiles	TCL Semi-Volatiles	Pesticides	PCBs	Herbicides	Cyanide	EDB MTBE	TCLP
Surface/Sediment	415	415	415	125	125	125	125	125	125	125	
Subsurface	49	49	49	15	15	15	15	15	15	15	
Sediment	20	20	20	6	6	6	6	6	6	6	
Field Duplicates	46	46	46	14	14	14	14	14	14	14	
MS/MSD	46	46	46	14	14	14	14	14	14	14	
Disposal Analysis	10										10
TOTAL NUMBER OF SOIL/ SEDIMENT SAMPLES	586	576	576	174	174	174	174	174	174	174	10
AQEOUS SAMPLES	Number of Samples	Explosive	TAL Metals	TCL Volatiles	TCL Semi-Volatiles	Pesticides	PCBs	Herbicides	Cyanide	EDB MTBE	TCLP
Surface Water	5	5	5	2	2	2	2	2	2	2	
New Wells	43	43	43	13	13	13	13	13	13	13	
Existing Wells	24	24	24	7	7	7	7	7	7	7	
Field Blanks	8	8	8	2	2	2	2	2	2	2	
Trip Blank	8	8	8	2	2	2	2	2	2	2	
Equipment Rinsates	40	40	40	12	12	12	12	12	12	12	
Field Duplicates	9	9	9	3	3	3	3	3	3	3	
MS/MSD	9	9	9	3	3	3	3	3	3	3	
Disposal Analysis	10										10
TOTAL NUMBER OF AQUEOUS SAMPLES	156	146	146	44	44	44	44	44	44	44	10

4.4 Surface Water/Sediment Sampling

Surface water samples will be collected from ponds in and around the impact area as described in Section 3.1.4 of the Workplan. Surface water samples will be collected using the procedure in MMR SOP 1-1 (CDM, 1993).

Sediment samples will be collected at the same locations as surface water samples are collected. Sediment samples will also be collected from swales where runoff from the impact area concentrates as described in Section 3.1.4. Sediment samples at surface water sampling locations will be collected using the procedure in MMR SOP 1-1 (CDM, 1993). Sediment samples in swales, where there is no water, will be collected using the procedures for surface soil sampling (described in Section 3.1.4.2 and MMR SOP 1-3). Samples will be collected at 50 meter intervals along the thalweg (deepest part) of the swale. Swale sediment samples will be collected to a maximum depth of six inches using the procedures in MMR SOP 1-3 (CDM, 1993).

4.5 Subsurface Soil Sampling

Subsurface soil samples are to be obtained from soil borings performed for monitoring well installation and at other areas as described in Sections 4.1.2 and 4.1.4 of the Workplan. Subsurface soil samples are to be collected using either a 2-foot long 2-inch diameter split spoon sampler, or using a continuous 4-inch diameter rotosonic sampling sleeve. A portion of the recovered material for the desired sampling interval will be collected for headspace analysis, as described above. The remaining material within the split spoon or sampling sleeve will be homogenized in a stainless steel bowl and used to fill the sample bottles for the remaining parameters. During the conduct of each soil boring, samples will be stored until all samples have been screened so that a decision can be made as to which samples from that boring are to be submitted to the laboratory.

4.6 Well Development

Following installation, wells will be developed by mechanically surging and pumping prior to sampling. This development method is designed to maximize well yield by restoring the natural hydraulic properties of the formation possibly damaged during the drilling operation, and by altering the basic physical characteristics of the aquifer near the borehole allowing water to flow more freely into the well. Monitoring wells will be developed using a submersible pump.

Development will continue until the discharge water is sufficiently clear and free of sediment as determined by the on-site geologist. Each well will be developed for a maximum of four hours. During development, temperature, pH, and conductivity of the discharge water will be measured after the removal of approximately each well volume. Development will stop after these physical parameters have stabilized (temperature $\pm 1^{\circ}C$, pH $\pm$ 0.2 standard units for three consecutive readings, conductivity $\pm$ 10%). All development data and procedures will be recorded on well development logs and noted in field logbooks.

4.7 Water Level Measurement

Water level measurements in wells will be made as follows:

- Decontaminate tip of water level meter (sounding device) by wiping with soap impregnated cloth and then rinsing with HPLC-grade water.
- Lower tip into well until it touches the water surface (sound begins).
- Raise and lower tip and measure from the permanently marked (e.g., notched) measuring point on the well casing.

- Mark point on cable and hold.
- Read cable to nearest foot marker and use engineer's ruler (tenths and hundredths of a foot) to measure increments of a foot to the nearest 0.01 foot.
- Record water level in logbook.

4.8 Well Purging

The water level in each well will be measured and recorded in a log book before purging of the well begins. Prior to collection of samples, each well will be purged as follows:

- Decontaminate purging equipment such as a submersible pump
- The ground water level, in addition to the depth of the well will be measured prior to lowering the purging device into the well.
- Lower purging device to one foot below the water level.
- Begin removing water at a pumping rate of 0.2 to 0.5 liters per minute in accordance with the EPA Low Flow Purge and Sample Methodology.
- Measure the water level every three to five minutes, adjusting the submersible pump flow as required to prevent water table fluctuation of more than 0.3 feet.
- Measure pH, conductivity, turbidity, dissolved oxygen, temperature, and oxidation/reduction potential (ORP/Eh) every three to five minutes.
- Continue purging until three consecutive readings of the physical parameters indicate stabilization (turbidity <1 NTU or ± 10% if >1 NTU; pH ± 0.2 s.u.; conductivity ± 3%; DO ± 10%; ORP/Eh ± 10 millivolts; and temperature ± 3%).
- If the well is low-yielding and purging of three well volumes is determined to be impractical, a minimum of one volume will be purged.
- Groundwater samples from a given well will be collected within 24 hours after completion of purging, once the water level has recovered to at least 80% of the measured level.
- All purging procedures, pumping rate changes, and other data will be recorded on groundwater sampling forms and noted in the field logbook.

4.9 Groundwater Sampling

Groundwater samples will be collected from all the new and a selected number of existing wells as part of the investigation. A submersible pump and Teflon® tubing will be used to collect the samples. For each well sampled, new Teflon® tubing will be used and discarded after sample collection is completed. The submersible pump will be decontaminated as described in Section 5.1 of the Workplan. Sample containers will be filled directly from the tubing.

Groundwater samples for total metals analysis will be preserved with nitric acid. Sample containers for volatile organic analyses (VOA) will be filled such that no headspace or air bubbles remain in the bottle. Samples for volatiles analysis will be preserved with HCL. Samples for EDB analysis will be preserved with

HCL. Acid preservatives will be added to the sample containers by the laboratory prior to shipping containers to the field. The laboratory will confirm proper preservation through a pH test after sample receipt.

4.10 Sampling Handling and Shipping

4.10.1 Bottle Preparation

It is important to use the proper sample containers so that no chemical alteration occurs between the field sampling and transit to the laboratory. The sample bottles will be prepared using USEPA Methods, and shipped to the field by the laboratory or commercial supplier.

Sample containers will be selected to ensure compatibility with the waste and to minimize breakage during transportation. Aqueous phase samples for organic analyses will be placed in glass vials with Teflon®-lined screw-type caps. Sample labels will be filled out at the time of sampling and affixed to each container to identify site name, the sample number, collector's name, date and time of collection, type of sample (grab or composite), matrix (groundwater or soil), location of sampling point, preservatives added, and analyses to be performed.

4.10.2 Sample Packaging and Shipping

After the bottles for each site sample have been filled, they will be placed in a shipping container. Those samples requiring preservation at 4 $^{\circ}$C will be covered with ice packs or crushed ice in plastic bags and placed in an insulated cooler containing a temperature blank. Crushed ice or ice packs will be added to the shipping coolers as the samples are collected. Each sample container (cooler) will be sealed using tamper-proof security tape for shipment to the designated laboratory by overnight express courier. Daily sample collection activities will end in time to allow shipment preparation for overnight delivery.

A completed chain-of-custody record will accompany each sample to provide documentation and to trace sample possession. Chain-of-custody procedures are discussed in detail in Section 5 of this QA/QC plan.

4.11 Field Logbook Records

All information concerning on-site activities will be kept in logbooks. The logbooks will consist of the site logbook, field logbooks, and field equipment logbook. The site logbook is the master document and it will contain actual field data or references to field logbooks, field equipment logbooks, and any other field documents. All site activities will be listed and the document will be signed at the end of each day. It will also contain lists of personnel on-site and a master list of field logbooks and field equipment logbooks.

Field logbooks will be kept by individual personnel working on-site and will document all field activities. All information pertinent to sampling (including instrument calibration data) will be recorded in field logbooks. These books will be bound and pages will be consecutively numbered. Entries in the logbook will be made in black, waterproof ink and will include, as a minimum, a description of all activities, individuals involved (sampling and oversight), date and time of sampling, weather conditions, any problems encountered, and all field measurements. A plan of each day's activities and a summary of each day's accomplishment will also be entered.

Sufficient information will be recorded during the sampling trip to permit reconstruction of the event without any reliance on the memory of field personnel. Shelf life, log numbers, manufacturer, and expiration dates of buffer and standard solutions used for field instrumentation will also be recorded in the field logbooks. The field equipment logbook will document the proper use, maintenance, calibration, and problems experienced with field equipment. The log will be signed and dated by the personnel using the equipment.

5.0 SAMPLE CUSTODY

The sample custody and documentation procedures described in this section will be followed during sample collection. Each person involved with sample handling will be trained in chain-of-custody procedures prior to the implementation of the field program. To reduce the chance for error, the number of personnel handling the samples will be restricted.

All samples will be accompanied by a complete Chain-of-Custody (COC) Record, an example of which is shown in Figure 5-1. A COC seal, an example of which is shown in Figure 5-2, will be fixed on each shipping container so that it cannot be opened without breaking the seal. A COC Record will accompany the sample during shipment to the laboratory and during analysis. If samples are split and sent to different laboratories, a copy of the COC Record will accompany each split sample. When transferring samples, the individuals relinquishing and receiving the samples will sign, date, and note the time.

The original copy of the COC Record will accompany the samples to the laboratory. The laboratory will maintain one file copy, and the completed original will be returned to the Project Manager as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler to the laboratory.

5.1 Sample Custody

A sample is under custody if:

- It is in the actual possession of the Field Sample Custodian (FSC); or
- It is in view of the FSC, after being in the physical possession of the FSC; or
- It was in physical possession and then locked up by the FSC to prevent tampering; or
- It is in a designated and identified secure area.

5.2 Sample Custody in the Field

The following procedures will be used to document, establish, and maintain custody of field samples:

- Sample labels will be completed for each sample, using black, waterproof ink, ensuring that the labels are legible and affixed firmly to the sample container.
- All sample-related information will be recorded in the project logbooks.
- The FSC will retain the custody of the samples until they are transferred or properly dispatched.
- During the course and at the end of the field work, the Field Supervisor will determine whether these procedures have been followed, and if additional samples are required.

5.3 Transfer of Custody and Shipment

In transferring and shipping samples, the following procedures will be used:

- Samples will be accompanied by a COC Record at all times. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note

CHAIN OF CUSTODY RECORD

REGULATORY CLASSIFICATION - PLEASE SPECIFY

☐ NPDES ☐ DRINKING WATER ☐ RCRA ☐ MCP ☐ OTHER

REQUI	
CUST. P.O. #	
QUOTE #	

TURN AROUND

- ☐ 15 BUSINESS DAY
- ☐ 10 BUSINESS DAY
- ☐ RUSH
- ☐ OTHER

COMPANY	CONTACT PERSON	PROJECT I.D.	PHONE #	FAX #

ADDRESS		
CITY	**STATE**	**ZIP**

DATE	TIME	SAMPLE I.D.	MATRIX	CONTAINER TYPE	# OF CONTAINERS	PRESERVATIVES	REQUESTED PARAMETERS	(COMMENTS)

SAMPLED BY: _____ _____
(PRINT NAME) (SIGNATURE)

RELINQUISHED BY *(SIGNATURE)*	DATE / TIME	RECEIVED BY	DATE / TIME
RELINQUISHED BY *(SIGNATURE)*	**DATE / TIME**	**RECEIVED FOR LAB BY**	**DATE / TIME**

FIELD REMARKS

03/13/1997 11:23 5086926633 OGDEN PAGE 02

CUSTODY SEAL

Person Collecting Sample _____ Sample No. _____

(Signature)

Date Collected _____ Time Collected _____

FIGURE 5-2 CUSTODY SEAL EXAMPLE

- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separated signed COC Record enclosed in each sample box or cooler. Shipping containers will be custody-sealed using tamper-proof security tape for shipment to the laboratory by overnight express courier.

- Whenever samples are split with a facility or government agency, a separate COC Record will be prepared for those samples and marked to indicated with whom the samples are being split.

- All packaged will be accompanied by the COC Record showing identification of the contents. The original COC Record will accompany the shipment, and a copy will be retained by the Field Supervisor.

- If sent by a common carrier, a bill of lading will be used. Receipts of bills of lading will be retained as part of the permanent documentation.

5.4 Laboratory Custody Procedures

The laboratory chosen to conduct the analysis of samples will, as a minimum, check all incoming samples for integrity and note any observations on the original COC Record. The temperature of the cooler blank will be recorded on the COC Record. Each sample will be logged into the laboratory system by assigning it a unique sample number. This number and the field sample identification number will be recorded on the laboratory report. Samples will be stored and analyzed according to specified methods. The original COC Record will be returned to the Project Manager for permanent storage.

The following procedures will be used by the Laboratory Sample Custodian (LSC) in maintaining the chain-of-custody once the samples have arrived at the laboratory:

- The samples are received by the laboratory will be cross-checked to verify that the information on the sample labels matches that one the COC Record included with the shipment.

- If all data and samples are correct, and there has been no tampering with the custody seals, the "received by laboratory" box will be assigned and dated.

- The samples will be distributed to the appropriate analysts with names of individuals who receive samples recorded in internal laboratory records.

For data that are input by an analyst and processed using a computer, a copy of the input will be kept and identified with the project number and other information as needed.

If the data are directly acquired from instrumentation and processed, the analyst will verify that the following are correct:

- Project and sample numbers;

- Calibration constants and response factors;

- Output parameters such as units of measurements; and

- Numerical values used for detection limits if a value is reported as "less than," below detection limit (BDL)," or "not detected (ND)."

5.5 Final Evidence Files

This project will require the administration of a central project file. The data and records management protocols will provide controls and retention of all materials related to the project. Record control will include receipt from external sources, transmittals, transfer to storage and indication of record status. Record retention will include receipt at storage areas, indexing, filing, storage, maintenance, and retrieval.

5.5.1 Record Control

All incoming materials related to the project including sketches, correspondence, authorization, and logs will be forwarded to the Project Manager or designee. These documents will be placed in the project file as soon as is practical. If correspondence is required for reference by project personnel, a copy will be made rather than retaining the original. All records will be legible and easily identifiable.

Examples of the types of records that will be maintained in the project file are:

- Field documents;
- Correspondences;
- Photographs;
- Laboratory data;
- Reports; and
- Procurement agreements

Outgoing project correspondences and reports must be reviewed and signed by the Project Manager prior to transmittal. The office copy of all outgoing documents will bear distribution information.

5.5.2 Record Status

To prevent the inadvertent use of obsolete or superseded project-related procedures, all the personnel of the laboratory and project staffs will be responsible for reporting changes in protocol to the Project Manager and/or the Laboratory manager. The Project Manager and/or Laboratory Manger will then inform the project and laboratory staffs and the Project Quality Assurance Officer of these changes.

Revisions to procedures will be subject to the same level of review and approval as the original document. The revised document will be distributed to all holders of the original document and discussed with project personnel. Outdated procedures will be marked "void." The voided document may be destroyed at the request of the Project Manager with the exception of one copy of the document which will be maintained in the project file. The reasons for and the date the document was voided should be recorded.

5.5.3 Record Storage

All project-related information will be maintained by The contractor. Designated personnel will assure that incoming records are legible and in suitable condition for storage. A records index will be initiated at the beginning of the project. Each document that is placed into the project file will be logged. The logging of the records will be the responsibility of the Project Manager and/or his designee.

Record storage will be performed in two stages:

- Storage during and immediately following the project; and
- Permanent storage of records directly related to the project.

Both phases will use storage facilities that provide a suitable environment to minimize deterioration or damage, and that prevents loss. The facilities will, where possible, have controlled access and provide protection from excess moisture and temperature extremes. Records will be secured in steel file cabinets labeled with the appropriate project identification. The removal of records from all files during both stages will be controlled by the use of withdrawal cards.

At the completion of the project, the Project Manager or his appointed document custodian will be responsible for inventorying the project file. The records contained in the project file will be compared against the records listed on the file index sheets. Discrepancies must be resolved prior to transferring the file to a permanent storage facility. All material from the project file, including drawings, project-related quality assurance documents, and software program documentation and verification records will be permanently retained. Duplicate records may be made and stored and a separate location.

All storage systems will provide for the prompt retrieval of information for reference or use outside the storage areas. Project records will be accessible to NGB for a period of three years after completion of this project.

5.5.4 On-Site Control

A file, similar to the project central file, will be established and maintained by field personnel under the direction of the Field Team Leader. Upon completion of the field program, the on-site file will be integrated with the office project files.

6.0 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used to collect, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications.

6.1 Field Equipment

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions require. Field instruments will include a pH/ORP meter, thermometer, specific conductivity meter, turbidimeter, dissolved oxygen meter, and PID

- The pH/ORP meter will be calibrated with standard buffer solutions prior to initiation of field activities. In the field, the meter will be calibrated daily with standard buffers before use. Thereafter, the meter will be checked against two buffers as deemed necessary by the Field Team leader. Fresh NIST traceable buffer solutions will be used for each field trip. Calibration procedures and frequency will be recorded in a field logbook, along with the lot numbers of the buffers. The pH/ORP meter will be checked for instrument drift at the end of each day.

- The thermometer will be calibrated by the manufacturer and checked daily with a NIST-certified thermometer.

- The conductivity cells of the specific conductivity meter will be cleaned and checked against known conductivity standards prior to field activities. In the field, the instrument will be checked daily with NIST traceable standards. The meter will be checked for instrument drift at the end of each day.

- The PID meter will be calibrated at the beginning and end of each days use to check for instrument drift. Calibration activities and frequency, calibration gas concentration and lot number will be recorded in the field logbook.

- The turbidimeter will be calibrated daily (and at the beginning of each sampling event) using 1 or 2 standards provided by the manufacturer. The turbidimeter will be checked at the end of each day for instrument drift.

- The DO meter will be calibrated daily and will be checked at the end of each day for instrument drift.

6.2 Laboratory Equipment

Calibration of laboratory equipment will be accomplished according to CLP methods for the TCL/TAL analysis and the approved methods for all other analyses. Records of calibration, repairs, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. These records will be filed at the location where the work is performed and will be subject to QA audit. For all instruments, the laboratory will maintain a factory-trained repair staff with in-house spare parts, or maintain service contracts with vendors. A summary of quality control activities, frequencies, acceptance criteria, and corrective actions is provided in Table 6-1.

Table 6-1. Summary of Internal Quality Control Procedures

Method	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
ILM04.0	Metals	Duplicate	One per prep batch (20 samples or less) for each matrix, or per Sample Delivery Group, whichever is more frequent.	RPD[1] must not exceed 20% for original and duplicate sample values greater than or equal to 5× CRDL. A control limit of ±CRDL is used when applicable.	1. If sample and duplicate are below IDL, the RPD is not calculated. If both values are below the CRDL, then no control limit is applicable. 2. If sample and/or duplicate is below 5× CRDL and the absolute difference between the sample and duplicate result is at or below CRDL, results are qualified as "in control." 3. If sample and/or duplicate is below 5× CRDL and the absolute difference between the sample and duplicate result is above the CRDL, results are qualified as "out of control." 4. If sample and duplicate are more than 5× the CRDL and the RPD is greater than 20%, qualify (flag) the data. 5. Document in case narrative.

Table 6-1. Summary of Internal Quality Control Procedures (cont.)

Method	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
		Method (Prep) Blank	One per digestion batch (20 samples or less) for each matrix or for each Sample Delivery Group, whichever is more frequent.	Must not exceed the analyte CRDL.	1. If the absolute value of the blank is less than or equal to the CRDL, no correction of sample results is performed. 2. If any analyte concentration in the blank is above the CRDL and the lowest concentration of that analyte in the samples is greater than or equal to 10× the blank concentration, no corrective action is required. 3. All samples associated with the contaminated blank with the analyte's concentration less than 10× the blank concentration and above the CRDL, shall be redigested and reanalyzed for that analyte. 4. If the blank is below the negative CRDL, all samples reported below 10× CRDL associated with the blank shall be redigested and reanalyzed. 5. Document in case narrative.
		LCS	One per batch (20 samples or less) for each matrix or per Sample Delivery Group, whichever is more frequent.	Must bewithin the 80-120% control limits for an aqueous LCS (exception: Ag and Sb). Solid LCS results must fall within the certified control limits.	1. For an out of control LCS, the analyses shall be terminated, the problem corrected, and associated samples redigested and reanalyzed. 2. Document in case narrative.

Table 6-1. Summary of Internal Quality Control Procedures (cont.)

Method	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
	Metals	Matrix Spike	One per prep batch (20 samples or less) or for each Sample Delivery Group (SDG), whichever is more frequent.	Percent recovery must not exceed the control limits of 75-125%.	1. If spiked sample is out of control, qualify (flag) the data. 2. If sample concentration is > 4× spike concentration, no limits apply. 3. If spiked sample ≤ spike concentration and LCS and RS are within limits, perform method of standard additions and report result with appropriate flag.
		Initial Calibration	Daily	All analyses must fall within the working linear range of the instrument.	1. Dilute the sample to bring it within the working linear range.
		Initial Calibration Verification	Immediately following initial calibration.	Percent recovery of all target analytes must fall within 90-110%.	1. Terminate the analysis. Identify the source of contamination . Recalibrate, and reanalyze the preceeding 10 samples.
		Continuing Calibration Verification	At a frequency of 10% or every two hours.	Percent recovery of all target analytes must fall within 90-110%.	1. Terminate the analysis. Identify the source of contamination . Recalibrate, and reanalyze the preceeding 10 samples.
		Initial Calibration Blank	Following the initial calibration verification.	The blank must be free from contamination above the CRDL.	1. Terminate the analysis. Identify the source of contamination . Recalibrate, and reanalyze the preceeding 10 samples.
		Continuing Calibration Blank	Following the continuing calibration verification.	The blank must be free from contamination above the CRDL.	1. Terminate the analysis. Identify the source of contamination . Recalibrate, and reanalyze the preceeding 10 samples.

Table 6-1. Summary of Internal Quality Control Procedures (cont.)

Method	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
OLM03.1	VOCs	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group.	Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.	1. If spiked sample is outside laboratory control limits, qualify (flag) the data. 2. If sample concentration is greater than 4× spike concentration, no limits apply.
		Method (Prep) Blank	One per extraction batch (20 samples or less).	Must not exceed CRQLs.	1. Re-extraction of the entire batch of samples. 2. Document on C.A.[3]
		LCS	One per extraction batch (20 samples or less).	Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized).	1. Re-extraction and reanalysis of the entire batch of samples. 2. Document on C.A.[3]
		Surrogates	Per sample.	Per analyte as specified in the SOW.	1. Identify potential source of problem. Reanalyze.
		Internal Standards	Per sample.	Per analyte as specified in the SOW.	1. Identify potential source of problem. Reanalyze.
		Instrument Tune	Every 12 houirs.	As specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.
		Initial Calibration	As required by failing continuing calibration or change in instrumentation.	Minimum RRF and RSD as specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.
		Continuing Calibration	Every 12 hours.	Minimum RRF and %D as specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.

Table 6-1. Summary of Internal Quality Control Procedures (cont.)

Method	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
OLM03.1	SVOCs	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group.	Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.	1. If spiked sample is outside laboratory control limits, qualify (flag) the data. 2. If sample concentration is greater than 4× spike concentration, no limits apply.
		Method (Prep) Blank	One per extraction batch (20 samples or less).	Must not exceed CRQLs.	1. Re-extraction of the entire batch of samples. 2. Document on C.A.[3]
		LCS	One per extraction batch (20 samples or less).	Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized).	1. Re-extraction and reanalysis of the entire batch of samples. 2. Document on C.A.[3]
		Surrogates	Per sample.	Per analyte as specified in the SOW.	1. Identify potential source of problem. Reextract. Reanalyze.
		Internal Standards	Per sample.	Per analyte as specified in the SOW.	1. Identify potential source of problem. Reextract. Reanalyze.
		Instrument Tune	Every 12 houirs.	As specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.
		Initial Calibration	As required by failing continuing calibration or change in instrumentation.	Minimum RRF and RSD as specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.
		Continuing Calibration	Every 12 hours.	Minimum RRF and %D as specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.

Table 6-1. Summary of Internal Quality Control Procedures (cont.)

Method	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
OLM03.1	P/PCBs	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group.	Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.	1. If spiked sample is outside laboratory control limits, qualify (flag) the data. 2. If sample concentration is greater than 4× spike concentration, no limits apply.
		Method (Prep) Blank	One per extraction batch (20 samples or less).	Must not exceed CRQLs.	1. Re-extraction of the entire batch of samples. 2. Document on C.A.[3]
		LCS	One per extraction batch (20 samples or less).	Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized).	1. Re-extraction and reanalysis of the entire batch of samples. 2. Document on C.A.[3]
		Surrogates	Per sample.	Per analyte as specified in the SOW.	1. Identify potential source of problem. Reextract. Reanalyze.
		Initial Calibration	As required by failing continuing calibration or change in instrumentation.	RSD as specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.
		Continuing Calibration	Every 12 hours.	%D as specified in the SOW.	1. Identify potential source of problem. Recalibrate. Reanalyze.
SW-846 Method 8330	Explosives	Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One MS/MSD per prep batch (20 samples or less) for each matrix or for each Sample Delivery Group.	Recoveries and/or RPDs must not exceed subcontracting laboratory's control limits.	1. If spiked sample is outside laboratory control limits, qualify (flag) the data. 2. If sample concentration is greater than 4× spike concentration, no limits apply.

Table 6-1. Summary of Internal Quality Control Procedures (cont.)

Method	Parameter	QC Check	Frequency	Acceptance Criteria	Corrective Action
		Method (Prep) Blank	One per extraction batch (20 samples or less).	Must not exceed Reporting limits.	1. Re-extraction of the entire batch of samples. 2. Document on C.A.[3]
		LCS	One per extraction batch (20 samples or less).	Must not exceed LCS limits supplied by the manufacturer (when sufficient data are gathered, laboratory established limits will be utilized).	1. Re-extraction and reanalysis of the entire batch of samples. 2. Document on C.A.[3]
		Surrogates	Per sample.	Per analyte as specified in the laboratory QAPP.	1. Identify potential source of problem. Reextract. Reanalyze.
		Initial Calibration	As required by failing continuing calibration or change in instrumentation.	RSD as specified in the method	1. Identify potential source of problem. Recalibrate. Reanalyze.
		Continuing Calibration	Every 10 samples.	%D as specified in the method	1. Identify potential source of problem. Recalibrate. Reanalyze.

[1] RPD = Relative Percent Difference
[2] N/C = Not Calculable
[3] C.A. = Subcontracting Laboratory Forms (Corrective Action/Out-of-Control Events; Re-Extraction/Out-of-Control Events; Re-Digestion/Out-of-Control Events)

7.0 ANALYTICAL PROCEDURES

USEPA CLP published methods OLM03.1 and ILM04.0, or the latest version at the time of analysis, will be used for all analyses for which such methods exist. EDB and TPH aqueous analysis will be performed according to EPA methods 504 and 418.1 respectively. TPH soil analysis will be performed according to Region I DAS Method. TCLP analysis for site was disposal purposes will be performed according to Federal Register Vol. 57, No. 227, dated 11/92 and Vol. 55, No. 126, dated 6/90. These proceedures are in accordance with the Quality Assurance Project Plan (QAPP) and Standard Operationg Procedures (SOP) for environmental investigations at MMR.

Tables 7-1a through 7-1g show the lists of target compounds, the analytical methods refernces, and the typical method detection limits that will be used for the analytical program.

TABLE 7-2 (a): LIST OF EXPLOSIVES COMPOUNDS; ANALTYTICAL METHODS REFERENCE AND DETECTION LIMITS FOR AQUEOUS AND SOIL SAMPLES

Parameter	Method Reference	Detection Limit	
		Water(ug/L)	Soil(ug/g)
HMX	EPA 8330	0.072	0.076
RDX	EPA 8330	0.23	0.19
1,3-Dinitrobenzene	EPA 8330	0.088	0.043
1,3,5-Trinitrobenzene	EPA 8330	0.066	0.078
Tetryl	EPA 8330	0.25	0.17
Nitrobenzene	EPA 8330	0.19	0.084
2,4,6-Trinitrotoluene	EPA 8330	0.21	0.067
4-Amino-4,6-Dinitrotoluene	EPA 8330	0.11	0.083
2-Amino-2,6-Dinitrotoluene	EPA 8330	0.058	0.14
2,6-Dinitrotoluene	EPA 8330	0.17	0.073
2,4-Dinitrotoluene	EPA 8330	0.11	0.054
2-Nitrotoluene	EPA 8330	0.21	0.24
3-Nitrotoluene	EPA 8330	0.3	0.23
4-Nitrotoluene	EPA 8330	.20	0.24

TABLE 7-2 (b): TARGET COMPOUND LIST FOR VOLATILES, METHOD REFERENCES, MCL's SSL's AND DETECTION LIMITS

Analyte(s)	Maximum Contaminant Level Water (ug/L)	Generic Soil Screening Level (mg/Kg)	Method Detection Limit	
			Water (ug/L)	Soil (ug/g)
Chloromethane	n/a	n/a	0.252	0.0013
Bromomethane	n/a	n/a	0.250	0.00067
Vinyl Chloride	2	0.01	0.247	0.00072
Chloroethane	n/a	n/a	0.258	0.00087
Methylene Chloride	n/a	0.02	0.362	0.00041
Carbon Disulfide	n/a	32	0.249	0.00068
1,1-Dichloroethene	7	0.06	0.229	0.00038
cis-1,2-Dichloroethene	70	0.4	0.252	0.00045
trans-1,2-Dichlorethene	100	0.7	0.245	0.00055
Chloroform	100	0.6	0.306	0.00032
1,2-Dichloroethane	5	23	0.369	0.00027
2-Butanone	n/a	n/a	1.002	0.0018
1,1,1-Trichloroethane	200	2	0.295	0.00022
Carbon Tetrachloride	5	0.07	0.282	0.00061
Vinyl Acetate	n/a	170	1.430	0.0027
Bromodichloromethane	100	0.6	0.319	0.00027
1,1,2,2-Tetrachloroethane	n/a	0.003	0.329	0.00031
1,2-Dichloropropane	5	0.03	0.304	0.00041
cis-1,3-Dichloropropene	n/a	0.004	0.309	0.00023
trans-1,3-Dichloropropene	n/a	0.004	0.343	0.00016
Trichloroethene	5	0.06	0.356	0.00056
Dibromomethane	n/a	0.4	0.329	0.00019
1,1,2-Trichloroethane	5	0.02	0.434	0.00013
Benzene	5	0.03	0.288	0.00039
2-Chloroethyl Vinyl Ether	n/a	n/a	1.396	0.00029
Bromoform	100	0.8	0.310	0.0002
2-Hexanone	n/a	n/a	0.417	0.00039
4-Methyl-2-Pentanone	n/a	n/a	0.463	0.00057
Tetrachloroethene	5	0.06	0.251	0.00054
Toluene	1000	12	0.313	0.00075
Chlorobenzene	n/a	1	0.325	0.00036
Ethylbenzene	700	13	0.269	0.00061
Styrene	100	4	0.282	0.00026
Total Xylenes	10000	600	0.867	0.0011
Ethylene Dibromide	0.05	n/a	1.000	ND

Volatile Organics in water by GC/MS EPA 8260 (25ml Purge)
Volatile Organics in soil by GC/MS EPA 8240 (Capillary Column)

TABLE 7-2 (c): TARGET ANALYTE LIST FOR INORGANICS CONSISTUENTS; METHOD REFERENCES, MCL's, SSL's, AND DETECTION LIMITS

Analyte(s)	Method Reference	Maximum Contaminant Level Water (ug/L)	Generic Soil Screening Level (mg/Kg)	Method Detection Limit	
				Water (ug/L)	Soil (mg/Kg)
Aluminum	CLP-AES	n/a	n/a	15	10
Antimony	CLP-AES	6	5	43	1.7
Arsenic	CLP-AES	50	29	ND	ND
Barium	CLP-AES	2000	1600	0.8	0.12
Beryllium	CLP-AES	4	63	0.2	0.043
Cadmium	CLP-AES	5	8	3.2	ND
Chromium	CLP-AES	100	38	1.8	0.39
Cobalt	CLP-AES	n/a	n/a	5	0.38
Copper	CLP-AES	1300	n/a	8.7	0.55
Iron	CLP-AES	n/a	n/a	13	1.9
Lead	CLP-AES	15	400 [1]	ND	ND
Magnesium	CLP-AES	n/a	n/a	24	0.86
Manganese	CLP-AES	n/a	n/a	0.29	0.14
Mercury	CLP-CVAA	2	2	0.047	0.034
Nickel	CLP-AES	100 [2]	130	7.4	0.89
Potassium	CLP-AES	n/a	n/a	18	3.1
Selenium	CLP-AES	50	5	ND	ND
Silver	CLP-AES	n/a	34	4.5	0.16
Sodium	CLP-AES	n/a	n/a	37	15
Thallium	CLP-AES	2	0.7	ND	ND
Vanadium	CLP-AES	n/a	6000	1.7	0.16
Zinc	CLP-AES	n/a	12000	7.7	0.98
Cyanide	EPA 9012	200	n/a	2.4	0.096

[1] Based on the Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities (US EPA, 1994).

[1] Draft standard

AES - Atomic Adsorption Spectroscopy

CVAA - Cold Vapor Atomic Adsorption

ND- Not Determined

TABLE 7-2 (d): TARGET COMPOUND LIST FOR SEMI-VOLATILES; METHOD REFERENCES, MCL'S, SSL's, AND DETECTION LIMITS

Analyte(s)	Method Reference	Maximum Contaminant Level Water (ug/L)	Generic Soil Screening Level (mg/Kg)	Method Detection Limit	
				Water (ug/L)	Soil (ug/g)
N-Nitrosodimethylamine	CLP	n/a	1	0.23	0.017
Phenol	CLP	n/a	100	0.62	0.0082
Aniline	CLP	n/a	n/a	0.26	0.051
bis(2-Chloroethyl) ether	CLP	n/a	0.0004	0.29	0.011
2-Chlorophenol	CLP	n/a	4	0.27	0.011
1,2-Dichlorobenzene	CLP	600	17	0.32	0.0086
1,3-Dichlorobenzene	CLP	600	n/a	0.36	0.0096
1,4-Dichlorobenzene	CLP	75	2	0.32	0.0089
Benzyl Alcohol	CLP	n/a	n/a	0.29	0.01
2-Methylphenol	CLP	n/a	15	0.058	0.0082
bis(2-Chloroisopropyl) ether	CLP	n/a	n/a	0.35	0.056
4-Methylphenol	CLP	n/a	n/a	0.050	0.0077
N-Nitroso-n-dipropylamine	CLP	n/a	5 E-5	0.27	0.012
Hexachloroethane	CLP	n/a	0.5	0.35	0.009
Nitrobenzene	CLP	n/a	0.1	0.36	0.034
Isophorone	CLP	n/a	0.5	0.22	0.0086
2-Nitrophenol	CLP	n/a	n/a	0.24	0.0085
2,4-Dichlorophenol	CLP	n/a	1	0.16	0.0085
Benzoic Acid	CLP	n/a	400	6.6	0.025
bis(2-Chloroethyoxy) methane	CLP	n/a	n/a	0.25	0.0087
1,2,4-Trichlorobenzene	CLP	70	5	5	0.0096
Naphthalene	CLP	n/a	84	0.29	0.0092
4-Chloroaniline	CLP	n/a	0.7	0.77	0.047
Hexachlorobutadiene	CLP	n/a	2	0.30	0.008
4-Chloro-3-Methylphenol	CLP	n/a	n/a	0.28	0.0095
2-Methylnaphthalene	CLP	n/a	n/a	10	330
Hexachlorocyclopentadiene	CLP	50	400	0.17	0.0055
2,4,6-Trichlorophenol	CLP	n/a	0.2	10	0.0095
2,4,5-Trichlorophenol	CLP	n/a	270	10	0.009
2-Chloronaphthalene	CLP	n/a	n/a	0.12	0.0037
2-Nitroaniline	CLP	n/a	n/a	0.11	0.0096
Dimethylphthalate	CLP	n/a	n/a	0.084	0.0089

TABLE 7-2 (d) Cont.: TARGET COMPOUND LIST FOR SEMI-VOLATILES; METHOD REFERENCES, MCL's, SSL's, AND DETECTION LIMITS

Analyte(s)	Method Reference	Maximum Contaminant Level Water (ug/L)	Generic Soil Screening Level (mg/Kg)	Method Detection Limit	
				Water (ug/L)	Soil (ug/g)
Acenaphthene	CLP	n/a	570	0.21	0.0079
3-Nitroaniline	CLP	n/a	n/a	0.085	0.025
2-Nitrophenol	CLP	n/a	n/a	0.24	0.0085
4-Nitrophenol	CLP	n/a	n/a	0.39	0.022
Dibenzofuran	CLP	n/a	n/a	0.11	0.0034
2,4-Dinitrotoluene	CLP	n/a	0.0008	0.064	0.015
2,6-Dinitrotoluene	CLP	n/a	0.0007	0.22	0.0073
Diethylphthalate	CLP	n/a	470	0.23	0.011
4-Chlorophenyl phenyl ether	CLP	n/a	n/a	0.23	0.0067
Fluorene	CLP	n/a	560	0.22	0.0084
4-Nitroaniline	CLP	n/a	n/a	1.3	0.066
4,6-Dinitro-2-mehthylphenol	CLP	n/a	n/a	3.4	0.007
N-Nitrosodiphenylamine	CLP	n/a	1	0.23	0.017
4-Bromophenyl phenyl ether	CLP	n/a	n/a	0.21	0.0072
Hexachlorobenzene	CLP	1	2	0.21	0.0068
Pentachlorophenol	CLP	1	0.03	0.24	0.0083
Phenanthrene	CLP	n/a	n/a	5	0.0074
Anthracene	CLP	n/a	12000	0.24	0.0088
Di-n-Butylphthalate	CLP	n/a	2300	0.41	0.059
Fluoranthene	CLP	n/a	4300	0.23	0.0091
Benzidine	CLP	n/a	n/a	ND	ND
Pyrene	CLP	n/a	4200	5	0.016
Butyl Benzyl Phthalate	CLP	n/a	930	0.64	0.13
3,3'-Dichlorobenzidine	CLP	n/a	0.007	4.0	0.036
Benzo(a)Anthracene	CLP	n/a	2	0.19	0.0076
Bis(2-Ethylhexyl)Phthalate	CLP	n/a	3600	0.30	0.12
Chrysene	CLP	n/a	160	0.21	0.0091
Di-n-octyl Phthalate	CLP	n/a	2300	0.15	0.011
Benzo(b)Fluoranthene	CLP	n/a	5	0.16	0.0097
Benzo(k)Fluoranthene	CLP	n/a	49	0.16	0.0095
Benzo(a)Pyrene	CLP	0.2	8	0.15	0.0088
Indeno(1,2,3-cd)Pyrene	CLP	n/a	14	0.22	0.013
Dibenz(a,h)anthracene	CLP	n/a	2	0.28	0.012
Benzo(g,h,i)Perylene	CLP	n/a	n/a	0.32	0.019

TABLE 7-2 (e): TARGET COMPOUND LIST FOR PESTICIDES/PCBs; METHOD REFERENCES, MCL's, SSL's, AND DETECTION LIMITS

Analyte	Method Reference	Maximum Contaminant Level Water (ug/L)	Generic Soil Screening Level (mg/Kg)	Typical Method Detection Limit	
				Water (ug/L)	Soil (ug/g)
Alpha-BHC	EPA 8080	n/a	0.0005	0.0011	0.000064
Beta-BHC	EPA 8080	n/a	0.003	0.0012	0.000052
Delta-BHC	EPA 8080	n/a	n/a	0.0012	0.000083
Gramma-BHC(Lindane)	EPA 8080	0.2	0.009	0.0011	0.000071
Heptachlor	EPA 8080	0.4	23	0.0013	0.000038
Aldrin	EPA 8080	n/a	0.5	0.0016	0.00017
Heptachlor Epoxide	EPA 8080	0.2	0.7	0.0011	0.000054
Endosulfan I	EPA 8080	n/a	18	0.0013	0.00011
Dieldrin	EPA 8080	n/a	0.004	0.0012	0.000042
4,4'-DDE	EPA 8080	2	54	0.0023	0.000042
Endrin	EPA 8080	n/a	1	0.0021	0.000097
Endosulfan II	EPA 8080	n/a	n/a	0.0031	0.00016
4,4'-DDT	EPA 8080	n/a	32	0.0019	0.000043
Endrin Aldehyde	EPA 8080	40	n/a	0.0023	0.00015
Methoxychlor	EPA 8080	2	160	0.014	0.00035
Chlordane *	EPA 8080	3	10	0.016	0.00093
Toxaphene *	EPA 8080	0.5 [1]	31	0.43	0.013
AROCLOR-1016 *	EPA 8080	0.5 [1]	n/a	0.41	0.00092
AROCLOR-1221 *	EPA 8080	0.5 [1]	n/a	0.22	0.009
AROCLOR-1232 *	EPA 8080	0.5 [1]	n/a	0.15	0.0037
AROCLOR-1242 *	EPA 8080	0.5 [1]	n/a	0.67	0.0024
AROCLOR-1248 *	EPA 8080	0.5 [1]	n/a	0.29	0.00074
AROCLOR-1254 *	EPA 8080	0.5 [1]	n/a	0.016	0.00071
AROCLOR-1260 *	EPA 8080	0.5 [1]	n/a	0.025	0.00084

[1] MCL for total PCB concentrations is 0.5 ug/L

* Multipeak analytes

TABLE 7-2 (f): ACIDIC HERBICIDE ANALYTE LIST; METHOD REFERENCE, MCL's, SSL's, AND DETECTION LIMITS

Target Compounds	Method Reference	Maximum Contaminant Level Water (ug/L)	Generic Soil Screening Level (mg/Kg)	Typical Detection Limit	
				Water (ug/L)	Soil (ug/g)
2,4-D	EPA 8150B	70	n/a	0.043	0.0059
Dalapon	EPA 8150B	200	n/a	0.2	0.029
2,4-DB	EPA 8150B	n/a	n/a	0.16	0.003
Dicamba	EPA 8150B	n/a	n/a	0.082	0.0036
Dichlorprop	EPA 8150B	n/a	n/a	0.36	0.0088
Dinoseb	EPA 8150B	7	n/a	0.11	*
Pentachlorophenol	EPA 8150B	1	0.03	n/a	25
Picloram	EPA 8150B	500	n/a	n/a	25
2,4,5-TP (Silvex)	EPA 8150B	50	270	n/a	25
3,5-Dichlorobenzoic Acid	EPA 8150B	n/a	n/a	n/a	25
4-Nitrophenol	EPA 8150B	n/a	n/a	n/a	25
Chloramben	EPA 8150B	n/a	n/a	n/a	25
Bentazon	EPA 8150B	n/a	n/a	n/a	25
Acifluorfen	EPA 8150B	n/a	n/a	n/a	25
Total Petroleum Hydrocarbons	EPA 418.1	n/a	n/a	300	20
Ethylene dibromide in water	EPA 504	0.05	n/a	0.02	n/a
Ethylene dibromide in soil	SW-846 GC/PT	n/a	n/a	n/a	10

* Dinoseb is not recovered quantitatively by Method 8150B; therefor, a statistically valid MDL could not be determined

Table 7-1g Other Analytes

intentially left blank

8.0 FIELD AND LABORATORY CONTROL CHECKS

8.1 Field Quality Control Checks

As a check on field sampling quality assurance and quality control (QA/QC), trip blanks, field blanks, equipment rinseate samples, and field duplicates will be sent to the laboratory with specified frequencies. The frequency with which these samples will be taken, and the number of such samples, are discussed in this section. The numbers, types, and analytical parameters for quality control samples were summarized in Table 4-1.

8.1.1 Trip Blanks

Trip blanks are used to assure that contamination is not caused by sample storgae or shipping. A trip blank is defined as a sample bottle filled by the laboratory with analyte-free laboratory reagent water (HPLC-grade), transported to the site, handled like a sample but not opened, and returned to the laboratory for analysis. One trip blank will be sent with every container of volatile organic compounds samples sent to the laboratory. Trip blanks are analyzed for volatile organic compounds only.

8.1.2 Field Blanks

Field blanks are used to check the quality of water used in the decontamination process. A field blank is defined as water collected in a sample container at the site, processed like a sample, and transported to the laboratory for analysis. The water source must be the same water used in the final decontamination rinse (analyte-free, deionized or HPLC grade) and water used for steam cleaning. The decontamination water is generally organic-free deionized water. The water used for steam cleaning is potable tap water. A field blank will be collected for each sampling event and each water source. Field blanks will be analyzed for all target analytes.

8.1.3 Equipment Rinseate Blanks

Equipment rinseate blanks are used to determine the effectiveness of the field decontamination process. Equipment rinseate blanks are defined as deionized water used for decontamination; e.g., poured over field equipment that has been decontaminated. This rinseate water is then transferred to a sample bottle. Equipment rinseate samples will be taken every day that decontamination occurs. The equipment rinseate samples will be analyzed for the same analytes as the samples which are collected that day.

8.1.4 Field Duplicates and Split Samples

Field duplicates are used to measure precision of laboratory analyses. A field duplicate is defined as two or more samples collected independently at a sampling location during a single act of sampling. The total number of field duplicates for each analysis is equal to 10 percent of the samples collected, rounded to the next whole number, i.e. for 10 samples it would mean 1 duplicate; but for 11 samples, 2 duplicates would be required.

Field duplicates will be indistinguishable by the laboratory from other samples. Therefore, one complete sample set will be identified with a "coded" or false identifier which will be in the same format as other identifier used with this sample matrix. Both the false and true identifiers will be recorded in the field notebook. On the COC Records, the "coded" identifier will be used.

8.2 Laboratory Quality Control Checks

Quality control data are necessary to determine precision and accuracy of the analyses, and to demonstrate the absence of interferences and contamination of glassware and reagents. Laboratory-generated QC will consist

of blanks, replicates, standards, matrix spikes, surrogate spikes and blanks. Depending upon the particular method used, QC may or sample duplicate will be analyzed at a frequency of one for each 20 samples. EPA recommended matrix spiking solutions will be used to determine matrix effects. Surrogates will be added to all samples requiring GC/MS analyses or whenever the method specifies. At a minimum, one method blank will be processed for every 20 samples analyzed. Blank samples will be analyzed in order to assess possible contamination and determine which corrective measures may be taken, if necessary.

8.2.1 Analytical Replicates

Replicate samples are aliquots of a single sample that are split upon arrival at the laboratory or prior to analysis. Since it is anticipated that the concentrations of most parameters will be below the laboratory detection limits, precision data on replicate analyses will largely be derived from matrix spike duplicate data. Significant differences between two replicates that are split in a controlled laboratory environment will result in flagging of the affected analytical results.

8.2.2 Surrogate Spike Analysis

Surrogate spike analysis is used to determined the efficiency of recovery of analytes in the sample preparation and analysis. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method. A surrogate spike is prepared by adding to a sample (before extraction) a known amount of pure compound similar to that for which the sample is being analyzed. Surrogate compounds will be added to all samples that are to be analyzed for volatiles, semi-volatiles, pesticides/PCBs and EDB, including method blanks, duplicate samples, and matrix spikes using the compounds recommended in the respective methods. The compounds that will be used as surrogates and the required surrogate spike recovery limits are given in in the MMR quality assurance manual (CDM, 1993). If the recovery does not fall within these limits, the corrective actions described in the method will be implemented.

8.2.3 Matrix Spike/Duplicate Spike Analysis

This technique is used to determine the effect of matrix interference on analytical results. Aliquots of the same sample are prepared in the laboratory and each aliquot receives consistent treatment throughout the analytical method. Spikes are added at concentrations specified in the methods. The percent difference between the values of the spike duplicates is taken as a measure of the precision of the analytical method. A matrix spike duplicate sample is prepared in the same manner as the matrix spike sample. The matrix spiking compounds and control limits for percent recovery and RPDs are listed in Table 3.1. Matrix spike and matrix spike duplicate analyses will be used for TCL Volatiles, TCL Semi-volatiles and TCL Pesticide/PCB analyses. Matrix spike analysis and sample duplicate analysis will be used for TAL Inorganics, TPH and EDB analysis.

The results of the analyses will be reviewed by the laboratory supervisor. Deviations from the established QC criteria will be noted and reanalysis, or other corrective action will be instituted as appropriate for the situation.

8.2.4 Reagent Blanks

Reagent blanks will be run for all appropriate analyses to verify that the procedures used do not introduce contaminants that affect the analytical results. The reagent blank will be prepared by addition of all reagents to a substance of similar matrix as the sample. This blank will then undergo all of the procedures required for sample preparation. The resultant solution will be analyzed with the field samples prepared under identical conditions.

8.2.5 Performance Evaluation Samples

A performance evaluation (PE) sample will be obtained which contains certified concentrations of the target compounds which are anticipated to be identified at the site. The PE sample will be submitted to the

laboratory double-blind; the sample will be introduced into the sampling stream in the field and will be analyzed by the laboratory without the laboratory's knowledge of its significance. The results from the PE sample analysis will be evaluated with respect to proper identification of spiked target compounds and the acceptability of the resulting quantitation.

8.3 Quality Control and Audit

Quality control results will be calculated by the analyst and reviewed by the laboratory supervisor to determine the accuracy and precision of the analytical results. The Laboratory Supervisor or the Laboratory Manager will review all final reports and associated quality control data. Approval will be indicated by signature. Results will be recorded on the QC report. The QC results will also be used to prepared control charts for each test and type of matrix.

9.0 DATA REDUCTION, VALIDATION, AND REPORTING

9.1 Data Reduction

9.1.1 Field Data

Field measurements will be made by qualified field geologists, engineers, environmental scientists, and/or technicians.

Field data will be validated using four different procedures:

- Routine checks will be made during the processing of data, e.g., looking for errors in identification codes.
- Internal consistency of a data set will be evaluated. This step will involve plotting the data and testing for outliers.
- Checks for consistency of the data set over time will be performed. This can be accomplished by visually comparing data sets against gross upper limits obtained from historical data sets, or by testing for historical consistency. Anomalous data will be identified.
- Checks may be made for consistency with parallel data sets; i.e., data sets obtained from the same population (for example, from the same region of the aquifer).

The purpose of these validation checks and tests is to identify outliers; i.e., an observation that does not conform to the pattern established by other observations. Outliers may be the result of transcription errors or instrumentation breakdowns. Outliers may also be manifestations of a greater degree of spatial or temporal variability than expected.

After an outlier has been identified, a decision concerning its fact must be made. Obvious mistakes in data will be corrected when possible, and the correct values inserted. If the correct values cannot be obtained, the data may be excluded. An attempt will be made to explain the existence of the outlier. If no plausible explanation can be found for the outlier, it may be excluded, but a note to that effect will be included in the report. Also, an attempt will be made to determine the effect of the outlier with both inclusion and exclusion from the data set.

9.1.2 Laboratory Data

The procedures used for calculations and data reduction are specified in each analysis method reference previously. Concentration units will be listed on reports and any special conditions noted. The analysis report includes the unique sample number assigned to each sample, details of sample receipt, and report preparation.

9.2 Data Review and Validation

For 10 percent of the samples to be analyzed for TCL/TAL, data validation will be performed according to EPA Region I Laboratory Data Validation Function Guidelines for Evaluating Organic Analyses, and Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses, at the Tier III Level as referenced in the document Region I Tiered Organic and Inorganic Data Validation Guidelines, dated July 1, 1993. The analytical results for the remaining samples analyzed for TCL/TAL will be validated at the Region 1 Tier II level. Tier II and III data validation is performed in accordance with the region I Completeness Evidence Audit Program and the Region I Laboratory Data Validation Functional Guidelines.

Analytical results for samples subjected to analysis for EDB and TPH will be validated based on the Region I guidelines with control limits as stated in this QAPP at a Tier II level.

9.3 Reporting

For all analyses, data reporting will be according to CLP requirements as published in the current Statements of Work. For all analyses, as a minimum, the laboratory will indicate traceability to samples analyzed and contain the following information:

- Project identification.
- Field sample number.
- Laboratory sample number.
- Sample matrix description
- Data of sample collection.
- Data of sample receipt at laboratory.
- Analytical method description and reference citation.
- Individual parameter results.
- Date of analysis (extraction, first run, and subsequent runs).
- Quantitation limits achieved.
- Dilution or concentration factors.
- Corresponding QC report (to include method blanks, blank/spikes, and continuing calibration checks).

9.3.1 EPA Data Qualifiers

For all analytical reports, EPA defined data qualifiers will be required.

The seven EPA-defined data qualifiers for organics analysis are:

U - Indicates element was analyzed but not detected. Report as the Contract Required Quantitation Limit (CRQL). The CRQL must be reported upon the basis of dilutions made (and percentage moisture for soils).

J - Indicates an estimated value. A value less that CRQL but greater than Method Detection Limit (MDL) is reported. The CRQL must be adjusted for dilutions made.

B - The compound was detected in the blank as well as the sample.

E - Compounds identified whose concentrations exceed the calibrated range of the instrument receive this flag. When the sample is diluted and reanalyzed and compounds found in the original analysis are diluted out, both results are reported on separate analytical reports.

D - Identifies all compounds quantified when a sample has been diluted and reanalyzed.

X - Other flags may be required to properly qualify the results for a specific situation. The flag selected must be clearly defined in the Case Narrative. (If more than five qualifiers are required for a sample, use the "X" to flag to combine several other qualifiers and explain it in the Case Narrative. The combination of flags "BU" or "UB" is prohibited because the B flag is used only if the compound is found in the sample.)

The nine EPA defined data qualifiers for inorganic analysis are:

B - Reported value was obtained from a reading that was less than the contract required detection limited (CRDL) but greater than or equal to the instrument detection limit (IDL).

U - Analyte was analyzed for but not detected.

E - The reported value is estimated because of the presence of interference.

M - Duplicate injection precision was not met.

N - Spiked sample recovery was not within control limits.

S - The reported value was determined by method of Standard Addition (MSA).

W - Post-digestion spike recovery for furnace AA analysis is out of control limits while the sample absorbency is less than 50% of the spike absorbency.

* - Duplicate analysis is not within control limits.

+ - Correlation coefficient for MSA is less than 0.995.

9.4 Overall Data Quality Assessment

A qualitative and quantitative assessment of the quality of soil and water analytical data from the investigation conducted at the Massachusetts Military Reservation will be conducted to assess the quality control and data validation procedures. A discussion of data quality in terms of precision, accuracy, representativeness, comparability, and completeness will be included in the overall assesment process. Performance evaluation (PE) sample results will be evaluated as well as a summary of the overall usability of the analytical data as determined by this data quality assessment.

10.0 PERFORMANCE AND SYSTEM AUDITS

10.1 External Audits

Auditing of laboratories used for this project in order to assure that the laboratory is able to meet the requirements of this QAPP is the responsibility of the Oversight Committee and its contractor. Non-CLP laboratories will be audited by the Contractor early in the project so that any problems can be corrected before sample analyses are complete. A CLP Laboratory is defined as a laboratory which is currently participating in the Contract Laboratory Program (CLP) in the area of organic and/or inorganic analysis; and the analytical services provided by this laboratory is managed by the Contract Project Management Section (CPMS) of the Region I, and the Sample Management Office (SMO). All CLP laboratories will be available for an audit upon request USEPA's Technical Project Coordinator will be informed of the results of any audit within 7 days of the availability of audit findings.

10.2 Internal Audits

Quality assurance audits will be performed by the Project Quality Assurance Officer (PQAO) or designee. The PQAO will plan, schedule, and approve system and performance audits. These audits will be implemented to evaluate the capability and performance of project and Subcontractor personnel, items, activities, and documentation of the measurement systems. At times, the PQAO may request additional personnel with specific expertise from other project groups to assist in conducting performance audits. However, these personnel are not to have participated in nor have responsibility for the direct work associated with the performance audit. USEPA's Technical Project Coordinator will be informed of the results of any audit within 7 days of the availability of audit findings.

10.2.1 System Audits

Systems audits, performed by the PQAO or his designee, will encompass evaluation of QA components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation will be system audited. These audits will be performed once during the project. However, if conditions adverse to quality are detected, or if the Project Manager requests the PQAO to perform unscheduled audits, these activities will be instituted. The Systems Audit will consist of an inspection of the following procedures:

- Sampling
- Sample custody
- Sample storage and preservation
- Sample preparation
- Analytical methodology
- Data management
- Preventive maintenance
- Recordkeeping

10.2.2 Performance Audits

Performance audits will be conducted periodically through the duration of the project to determine the accuracy and implementation of the QA/QC Plan. As in system audits, the PQAO or assigned alternate will exercise planned and scheduled performance audits with the understanding that unplanned audits may be implemented if requested. Performance audits will be performed after the project begins to generate data. In addition to in-;house performance audits, the laboratory will also participate in inter-laboratory performance evaluation studies.

11.0 PREVENTIVE MAINTENANCE

11.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventative maintenance will be serviced in accordance with the manufacturer's specified recommendation. A typical maintenance schedule for major instrumentation is provided in Table 11-1. A schedule for specific equipment operated by the laboratory will be provided in this QA/QC Plan after the laboratory subcontractor(s) has(have) been selected. In the absence of any manufacturer's recommended maintenance criteria, a maintenance procedure will be developed by the operator based upon experience and previous use of the equipment.

11.2 Schedules

Manufacturer's procedures identify the schedule for servicing critical items in order to minimize the downtime of the measurement system. It will be the responsibility of the operator to adhere to this maintenance schedule, and to arrange necessary and prompt service as required. Service to the equipment, instruments, tools, gauges, etc. will be performed by qualified personnel.

11.3 Method-Specified Preventive Maintenance

In the event that a CLP or EPA method mandates specific preventive maintenance procedures which are more frequent than that recommended by the manufacturer, the frequency required in the method will be followed.

11.4 Records

Logs will be established to record maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges.

Records produced for laboratory instruments will be reviewed, maintained, and filed by the operators at the laboratories, and by field personnel for equipment, instruments, tools, and gauges which are used at the site. The project QA officer will audit these records to verify complete compliance with these procedures.

11.5 Spare Parts

A list of critical spare parts will be requested from the manufacturer and/or identified by the operator. These spare parts will be acquired and maintained use in order to reduce downtime.

GENERAL ANALYTICAL INSTRUMENTATION

	Furnace	Flame AA	UV-VIS Spectro Photometer	IR Spectro-meter	DI Water System	Balances	pH Meter
Cleaning Nebulizer		D,A					
Clean Capillaries		D,A					
Drain Burner Head		D,A					
Clean Burner Head		D,A					
Cleaning Contact Cylinders	D,A						
Changing Graphite Tubes	D,A						
Cleaning Furnace Windows	D,A						
Changing Contact Cylinders	W,A						
Check Lamp Alignment			D,A				
Check Fan Exhaust			D,A				
Clean Windows			Q,S	Q,I			
Clean Sample Cell				D,A			

	Furnace	Flame AA	UV-VIS Spectro Photometer	IR Spectro-meter	DI Water System	Balances	pH Meter
Check Gas Leak				D,A			
Clean Pan						D,A	
Replace Light Bulb						Y,S	
Adjust Scale Deflection						Y,I	
Check with Class "S" wts						M	
Refill Electrodes							W,S
Clean Electrodes							D,A
Check 3rd Wire Leakage	Y,I	Y,I	Y,I	Y,I		Y,I	Y,I
Check: conductivity, pH, and Bacteriological					B		
Check metals (6)					A		

GENERAL ANALYTICAL INSTRUMENTATION

	Pumps	DI Water System	UV-VIS Spectro-Photometer	I.R. Spectro-photometer	Balances	pH Meter
Cleaning	B					
Check conductivity		E				
Check pH		E				
Check for metals (b)		A				
Check for residual chlorine		M				
Check bacteriological		E				
Check Fan Exhaust			D,A			
Clean Windows			Q,S	Q,I		
Clean Sample Cell				D,A		
Check Gas Leak				D,A		
Clean Pan					D,A	
Replace Light Bulb					Y,S	
Adjust Scale Deflection					Y,I	
Check with Class "S" wts					M	
Refill Electrodes						W,S
Clean Electrodes						D,A
Check 3rd Wire Leakage		Y,I	Y,I	Y,I	Y,I	Y,I

GENERAL ANALYTICAL INSTRUMENTATION

	Gas Chromatograph	Purge and Trap Connector
Replace the Septum	W,A*	
Replace the Column	Q,A*	
Clean Injection Port	M,A*	
Clean Detector	M,A*	
Clean GC Syringes	D,A	
Replace Fan Purifier	Q,S	
Check Gas Supply	D,S	
Check Elect. Parts of Systems	Y,I	Y,I
Check 3rd Wire Leakage	Y,I	Y,I
Check for Leaks	D,A	D,A
Change Purge Assembly		W,A
Change Trap		Q,A
Check Trap Fan		W,A

GENERAL ANALYTICAL INSTRUMENTATION

	Gas Chromatograph/Mass Spectrophotometer	Purge and Trap Connector
Replace the Septum	W,A*	
Replace the Column	D,A	
Clean Injection Port	M,A*	
Clean Detector	M,A*	
Clean GC Syringes	D,A	
Replace Fan Purifier	Q,S	
Check Gas Supply	D,S	
Check Elect. Parts of Systems	Y,I	Y,I
Check 3rd Wire Leakage	Y,I	Y,I
Check for Leaks	D,A	D,A
Change Purge Assembly		W,A
Change Trap		Q,A
Check Trap Fan		W,A
Clean Source	*,S	
Alignment of Source	*,S	
Vacuum Pump	*,A	

GENERAL ANALYTICAL INSTRUMENTATION

	Inductively Coupled Plasma		Database Update
Check/Change Pump Tubing	W,A		
Cleaning/Changing Torch	*,A		
Filters	M,A		
Update IECs		Q,A	
Update Linear Ranges		Y,A	

THERMAL AND MECHANICAL DEVICES

	Sample Standard Refr.	Cooling System	Ovens Incubators	Hot Plates Digestors Dry Baths	Stirrers Shakers Centrifuges	Heating Mantels/Controllers	Stills	Flash Point Tester	General Purpose Vacuum Pumps	Main Air Compressor
Check all Operational Indicators	D,A	D,A	D,A	E,A	E,A	E,A	E,A	E,A		
Check Output Temp.	D,A	D,A	D,A	E,A		D,A				
Clean Condenser Coils	Q,A									M,I
Check Thermally Exposed Connections and Wires	Y,I	BY,I	BY,I	BY,I	Y,I	BY,I	BY,I	BY,I	BY,I	BY,I
Check 3rd Wire Leakage	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I	Y,I
Check Fluid Level		D,A							D,A	D,A

Key:
E = Each Use
D = Daily
W = Weekly
M = Monthly
Q = Quarterly
Y = Yearly
B = Prefix of BI (twice per period)
* = As needed, but not longer than otherwise specified
A = Analyst
S = Supervisor
I = Instrumentation Specialist

12.0 SPECIFIC ROUTING PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, AND COMPLETENESS

Procedures used to assess data precision and accuracy will be in accordance with 44 CRF 69533 "Guidelines Establishing Test Procedures for the Analyses of Pollutants," Appendix III "Example Quality Assurance and Quality Control Procedures for Organic Priority Pollutants," December 3, 1979, and the respective analytical method, and are described in Section II "Internal Quality Control Check." Completeness is recorded by parameters successfully completed and validated. For this project a target control limit of greater than 90 percent will be used.

12.1 Accuracy

The percent recovery (PR) is calculated as below:

$$PR = \frac{S_s - S_o}{S_A} \times 100$$

S_o = background value; e.e., value obtained by analyzing the sample

S_A = concentration of the spike added to the sample.

S_s = value obtained by analyzing the sample with the spike added.

PR = percent recovery

12.2 Precision

The relative percent difference (RPD) is calculated as below:

$$RPD = \frac{|S - D|}{\frac{1}{2}(S + D)} \times 100$$

where:

S = Concentration of analyte in first (original) sample (mg/kg or µg/l); and

D = Concentration of analyte in second (duplicate) sample (mg/kg or µg/l).

12.3 Completeness

The percent complete (PC) is calculated as follows:

$$PC = \frac{N_A}{N_I} \times 100$$

N_A = actual number of valid analytical results obtained.

N_I = theoretical number of results obtainable under ideal conditions.

13.0 CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to quality including malfunctions, deficiencies, deviations, and errors are promptly investigated, documented, evaluated, and corrected. Corrective actions are included in the summary of quality control activities in Table 6-1 of the QA/QC Plan.

13.1 Initiation of Corrective Action

When a significant condition adverse to quality is noted at the project site, laboratory, or subcontractor locations, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the Project Manager, PQAO, Field Team Leader, and involved Subcontractor management, as a minimum. Implementation of correction action will be verified by documented follow-up action. All project personnel have the responsibility, as part of their normal work duties, to promptly identify and report conditions adverse to quality, and solicit correction.

Corrective actions may be initiated, as a minimum:

- When predetermined acceptance standards are not attained (objectives for precision, accuracy, and completeness);
- When procedures or data compiled are determined to be incorrect or incomplete;
- When equipment or instrumentation is found to be malfunctioning;
- When samples and test results cannot be traced with certainty;
- When quality assurance requirements have been violated;
- When designated approvals have been circumvented;
- As a result of system and performance audits;
- As a result of a management assessment; or
- As a result of laboratory/inter-laboratory comparison studies.

13.2 Procedure Description

Project management and staff, including field investigation teams, quality assurance auditors, document, and sample control personnel, and laboratory groups, will monitor ongoing work performance in the normal course of daily responsibilities. Work will be audited at the site, laboratories, and Subcontractor locations by the PQAO or his designee, by NGB QA personnel, and/or by QA personnel in the State of Massachusetts or USEPA. Items, activities, or documents ascertained to be in noncompliance with QA requirements will be documented and corrective actions mandated through the audit report. Corrective actions will be logged, maintained, and controlled by the PQAO.

Following identification of an adverse condition or quality assurance problem, notification of the deficiency will be made to the Program Manager, the Project Manager, and the senior individual in charge of the activity found to be deficient, along with recommendations for correction. A record of this notification will be attached to the audit report. Following implementation of corrective action, the senior individual in charge will report actions taken and results to the Project Manager and the PQAO. The PQAO will notify the

Program Manger when conditions adverse to quality have been corrected. A record of action taken and results will also be attached to the audit report.

13.3 Variance Documentation

Any deviation from project requirements as specified in this document or the Statement of Work requires proper documentation using a Field Change Request Form (13.1). This form will be completed in the field by the Field Team Leader and forwarded to the Contracting Officer Representative (COR) by the most expedient communications means available. Upon receipt, the COR will review and indicate final disposition of the request and return the original document to the originator. A copy of the document should be retained for the project file. Changes that require an immediate response will be initiated by telephone or other telecommunication transmission, and then documented using the procedure described above.

14.0 QUALITY ASSURANCE REPORTS

Quality assurance reports to management consists of the reports on audits, reports on correction of deficiencies found in audits, a final QA report on field sampling activities, and a final analytical laboratory QA/QC report.

14.1 Field QA Audits

The mobilization stage will be audited before work begins to assure that all procedures, training, and materials are ready to support the QA Plan. Field activities may be audited during operation in order to assure compliance with the QA Plan. Additional audits may be required depending on the results of these audits. All audits and corrective actions will be reported in writing to the Program Manager and the Project Manager.

14.2 Analytical Laboratory QA/QC Reports

The laboratory will provide reports of their QA/QC program and results to the Project Manager at the completion of this investigation. These reports and a summary of the laboratory QA/QC program and results will be included in the final project report.

REFERENCES

EPA, "Interim Guidelines and Specifications for Preparing Qaulity Assurance Project Plans", February, 1983

CDM Federal Programs Corporation, "Quality Assurance Project Plan for Field Investigation at Massachusetts Military Reservation" June, 1993

CDM Federal Programs Corporation, "Quality Assurance Plan for Hazardous Waste Remedial Action Programs" January, 1992

EPA, "Guidance for conducting Remedial Investigations and Feasibility Studies Under CERCLA-Interim Final" 1988

Department of Energy, "Requirements for Quality Control of Analytical Data", July 1990

Department of Energy, "Standard Operating Procedures for Site Characterization", July 1990

EPA, "Region I Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses", November, 1988

EPA, "Region I Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses", February, 1989

DRAFT

HEALTH AND SAFETY PLAN

FOR

THE CAMP EDWARDS IMPACT AREA GROUNDWATER QUALITY STUDY

MASSACHUSETTS MILITARY RESERVATION

CAPE COD, MASSACHUSETTS

PREPARED FOR:

NATIONAL GUARD BUREAU

ARLINGTON, VIRGINIA

REVIEW AND APPROVALS:

_____ _____

HEALTH AND SAFETY MANAGER DATE

_____ _____

CORPORATE HEALTH AND SAFETY MANAGER DATE

_____ _____

PROGRAM MANAGER DATE

TABLE OF CONTENTS

1.0 WORKPLAN 3
1.1 Project Description 3
1.2 Anticipated Activities 3
1.3 Number of Field Personnel 3

2.0 TRAINING AND INFORMATION 4
2.1 Training 4
2.2 Information Programs 4
2.3 Medical Surveillance Program 5

3.0 SITE SPECIFIC HEALTH AND SAFETY PLAN 6
3.1 Hazard Analysis 6
3.1.1 Weather. 6
3.1.2 Noise. 6
3.1.3 Potential Contaminants. 6
3.1.4 Background 10
3.1.5 Utilities 10
3.1.6 Principal Hazards 10
3.2 Hazard Analysis of Each Site Work Task 12
3.3 Site Control 15
3.4 Emergency Response Plan 16

4.0 REFERENCES 18

1.0 WORKPLAN

1.1 Project Description

The purpose of this project is to study the groundwater quality beneath the training range, and impact area at the Massachusetts Military Reservation (MMR). A background review will be conducted to evaluate the hazards involved. Background samples will be used to evaluate soils and ground water data. Investigation wells will be installed within the impact area. Soil and ground-water samples will be collected and analyzed.

1.2 Anticipated Activities

The activities which are to be conducted as part of this study are drilling, soil sampling, investigation well installation, well development, and well sampling. The borehole drilling will be accomplished using a hollow-stem auger and rotosonic drilling. As the borehole is advanced, soil samples or drill return cutting samples will be collected. Portions of the samples obtained from the borehole will be placed into plastic bags or samples containers for subsequent analyses. After certain boreholes are completed, the investigation well will be installed by placing into the borehole casing and screen, sand/gravel pack, bentonite, and cement. After well installation is completed, the well will be developed using methods such as pumping, surging and bailing to remove sediment. The wells are later sampled using pumps or bailers.

1.3 Number of Field Personnel

For safety purposes, a minimum of two and a maximum of eight persons will be on site during all phases of the drilling and sampling. The site is an active military training facility, and subject to small arms and heavy artillery firing. Therefore, the number of personnel within this area should be kept at a minimum at all times. Regardless of the distance away from the firing range and impact area, work will not take place in the line of fire of any active use of the range.

2.0 TRAINING AND INFORMATION

2.1 Training

All contractor, subcontractor and consulting personnel involved in field work must have had a 40-hour course in health and safety for hazardous waste operations (OSHA 29 CFR 1910.120) and a current annual 8-hour refresher course as necessary. The Project Manager and Field Supervisors must have also had an 8-hour supervisor's course. All project personnel must have received a minimum of 3 days actual field experience under the direct supervision of a trained supervisor.

2.2 Information Programs

An initial site safety meeting and briefing will be held at MMR before any operations begin. At this meeting, the range safety and security rules and procedures will be carefully presented and discussed. As the project progresses, daily safety briefings will be held prior to initiating field drilling, well installation, development, and sampling work. The following topics will be discussed at each briefing:

(a) personnel roles,

(b) lines of authority and communication;

(c) anticipated hazards and control measures;

(d) air monitoring results from the previous day;

(e) emergency recognition and prevention;

(f) safe distances and places of refuge; and

(g) evacuation routes and procedures.

The following individuals acknowledge that they have been informed, read, understand and agree to comply with the contents of this SAFETY AND HEALTH PROGRAM.

Name	Signature	Date
_____	_____	_____
PROGRAM MANAGER		
_____	_____	_____
PROJECT MANAGER		

HEALTH AND SAFETY OFFICER		
FIELD SUPERVISOR		
GEOLOGIST		

2.3 Medical Surveillance Program

All project personnel involved in field work must be enrolled in a medical surveillance program which includes initial and annual medical examinations. These persons must have been approved by a physician as being fit to perform work of this type. Copies of the physician approval documentation for all personnel will be kept on-site.

3.0 SITE SPECIFIC HEALTH AND SAFETY PLAN

3.1 Hazard Analysis

3.1.1 Weather.

(a) The normal daily maximum temperature for this area during spring and early summer is expected to range from 60 and 85°F and the normal daily minimum temperature is expected to be about 45°F. If the air temperature is greater than 70°F then personnel will monitor and control for heat stress. The normal daily maximum temperature for this area during December is expected to be about 40°F and the normal daily minimum temperature is expected to be about 25°F.

(b) When air temperatures drop below 40°F (wind chill considered) precautionary measures will be taken to protect against frost. Extra insulating clothing will be worn and the duration of the exposure period will be reduced as necessary. Continuous exposure of exposed skin will not be permitted when wind chill or temperature drops to -25°F.

(c) Operations will cease at times of lightning, severe rain, and severe wind.

3.1.2 Noise.

During drilling operations, there may be some noise hazard. Hearing protection (including ear muffs or ear plugs) will be provided, required, and utilized.

3.1.3 Potential Contaminants.

Previous studies suggest a low potential to find minor amounts of certain contaminants. Figure 3-1 shows the potential drilling and sampling locations. Based on results of analysis of soil samples from sites within the range and impact areas, the following inferences can be drawn:

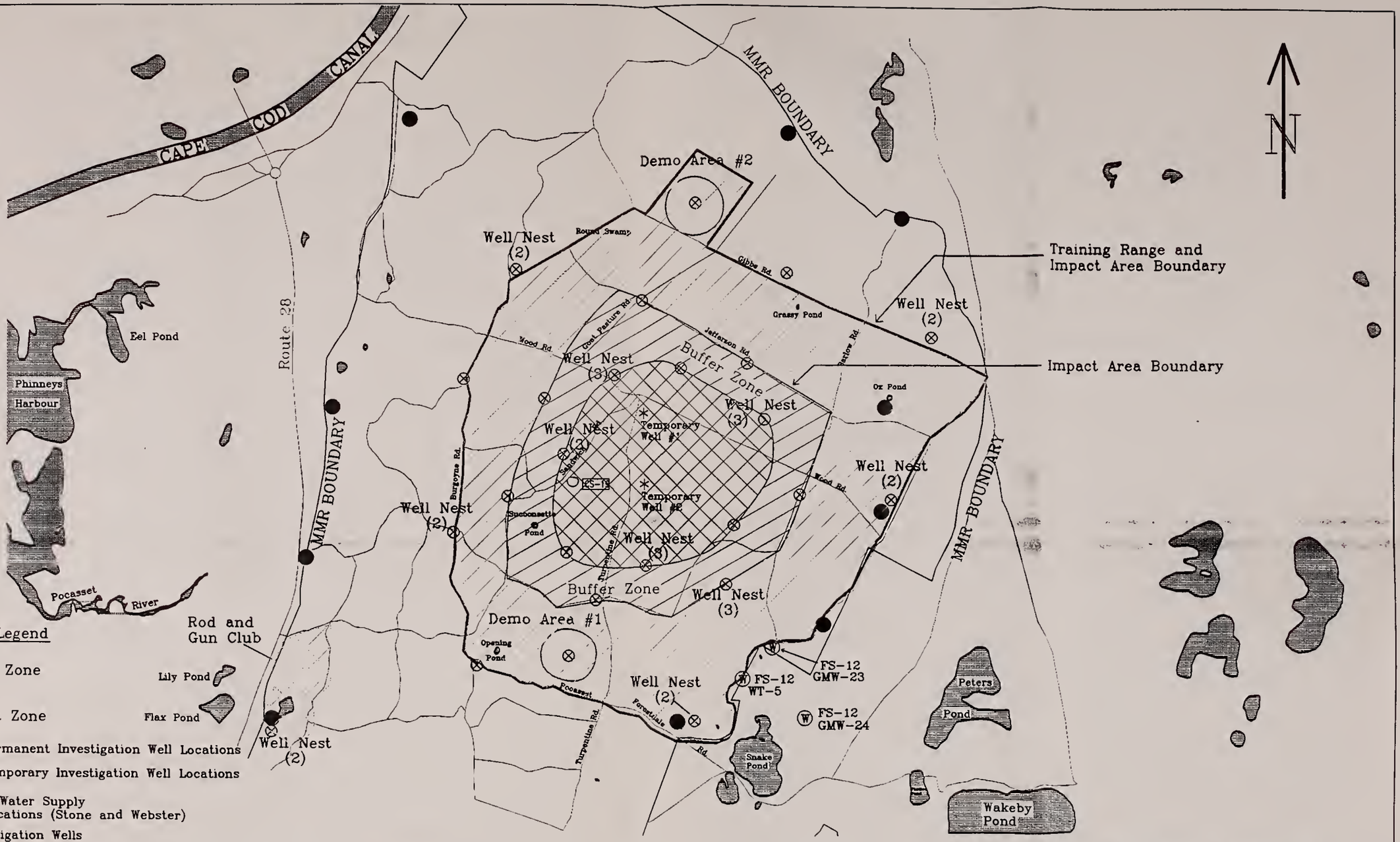
(a) Maximum levels of contaminants detected in the shallow soils in the impact area are presented in Table 1. On the basis of the results of the shallow soils contamination, ground-water contamination is not expected.

(b) The shallow soils contaminants are compared with levels derived from the "EPA Region III Risk-Based Screening Table". Where available, levels of contaminants were compared with screening levels for industrial soil.

(c) Risk-based screening levels were slightly exceeded for hexachlorabenzene, barium, and beryllium. Lead levels were higher than the 500-1,000 mg/kg range suggested in an EPA OSWER. Contact exposure will be minimized by the fact that the actual drilling will be performed outside the perimeter of the site of any suspected dumping. Also, nitrile gloves will be worn during developing, purging, and sampling. Ingestion exposures will be minimized by prohibiting eating, gum chewing, drinking, and smoking while on site. Inhalation exposure should be minimal because all field activities will be conducted outdoors, under well ventilated

conditions, and contaminants are generally expected to be absorbed in the soil matrix or in solution.

(d) Although not required, air monitoring will be performed as an added safety precaution. Monitoring of breathing zone air will be performed using a Photoionization detector (PID) calibrated for isobutylene. Approximately every 30 minutes, checks will be made downwind from the work site. Personal protective clothing and equipment will be upgraded to EPA Level C when the breathing zone readings exceed background levels. Survey personnel will be required



DESIGNED	AJH	2/97
DRAWN	AJH	2/97
CHECKED	MLL	2/97
APPROVED	DHK	2/97

ENGINEERING TECHNOLOGIES ASSOCIATES, INC.
ENGINEERS • PLANNERS • SURVEYORS
3458 ELLICOTT CENTER DRIVE SUITE 101
ELLICOTT CITY, MARYLAND 21043
BALTO. 461-9020 WASH. 621-4080

0 1000 2500 5000
SCALE (FEET)

MMR IMPACT AREA WORKPLAN

FIGURE 3-1
PROPOSED MONITORING WELLS
LOCATION MAP

SCALE: | CONTRACT NO.: 92307.012 | DATE: 2/97

TABLE 1-1. List of Suspected Contaminants

Parameter	Maximum Amount Detected mg/kg	EPA Generic Soil Screening Levels *1* mg/kg	OSHA PEL/ ACGIH TLVs mg/m^3
hexachlorabenzene	.6	2	NE / 0.025 skin, Ca
diethylphthalate	14	470	5.0 / 5.0
N-Nitrosodiphenylamine	0.38	1	NE / NE
2,4-DNT	0.71	0.0008	1.5 skin / 0.15 skin
PESTICIDES			
DDE	0.005	54	1.0 ca / 1.0 Ca
DDD	0.130	16	1.0 ca / 1.0 Ca
endrin ketone	0.0360	1	0.1 skin / 0.1 skin
endosulfan sulfate	0.009	18	0.1 skin / 0.1 skin
alpha chlordane	0.009	10	0.5 skin / 0.5 skin, Ca
gamma chlordane	0.010	10	0.5 skin / 0.5 skin, Ca
EXPLOSIVES			
HMX	2.713		NE / NE
TNT			1.5 skin / 0.5 skin
RDX			
	0.009	100(furan)	NE / NE
Dioxins and Furans			
HERBICIDES	0.029		NE / NE
dinoseb	232		NE / NE
MCPP			
INORGANICS	26100		15 / 10
aluminum	30.8	38	1.0 / 0.5
chromium (total)	156		1.0 / 1.0
copper	22700		5 / 5
iron	1830	400	0.05 / 0.05 Ca
lead	12200		15 / 10
magnesium	188		5 cel / 0.2
manganese	0.36	2	0.1 cel / 0.01
mercury	22.9	6000	0.5 cel / 0.05
vanadium	15.7	130	0.015 /0.1
nickel	4.7	29	0.5 / 0.01 Ca
arsenic	26000	1600	0.5 / 0.5
barium	1.2	63	0.005 Ca /0.002 Ca
beryllium	4.5	8	0.005 Ca /0.002 Ca
cadmium	1480		5.0 / 2.0
calcium	1200		NE / NE
potassium	5.9	34	0.01 / 0.01
silver	180	12000	15 / 10
zinc			

1. From EPA, July 1996, Soil Screening Guidance Technical Background Document Appendix A.
Skin = prevent skin contact.
Ca = Carcinogen.
Cel = Ceiling level
NE = None established

to wear air purifying full facepiece respirators with organic vapor cartridges. Contact lenses will not be worn. If the breathing zone readings exceed 5 ppm, drilling operations will be temporarily halted until the potential hazard can be further evaluated, and an appropriate course of action can be taken. The PID will be using an 10.6 eV lamp and will be maintained and calibrated using the manufacturers recommended procedures.

3.1.4 Background

Results of background level determined from previous investigations will used as background levels for this investigation.

3.1.5 Utilities

There are no underground utility lines in the areas to be investigated. However, all intrusive activities will be cleared through the housing and utilities management office before such activities are initiated. Overhead utilities will be reviewed prior to the drill rig setting up on locations. An abandoned pipeline does exist in the southeastern corner of the impact area.

3.1.6 Principal Hazards

3.1.6.1 Mechanical Hazards

The principal hazards to workers during this study will be the mechanical hazards associated with working around a drilling rig. These hazards include those related to handling ropes, cables, and auger equipment. They also include working around heavy equipment which is rotating or being lifted overhead. Other hazards include tripping and falling, heavy tools and equipment items falling on feet, and blows to the head.

3.1.6.2 Unexploded Ordance (UXO)

UXO may be encountered within the impact area which is still part of an active firing range. The impact area has been fired upon with weapons that include small arms to artillery as large as 8 inches. As a result of this firing, there is a potential to encounter UXO. Procedures for eliminating the UXO hazard are discussed below.

(a) A certified UXO contractor or the 102 CES/EOD from Otis Air National Guard Base, Massachusetts, will conduct a surface sweep and a magnetometer sweep at all sampling and well locations prior to site operations. The surface sweep will eliminate any UXOs on the ground surface. The magnetometer sweep will minimize the potential to encounter UXOs within a six feet of the surface. An initial sweep will be conducted prior to road building for site access. Because the impact area is still actively fired on during training activities, a second sweep will be performed prior to any activity within the area after any appreciable time breaks between activities (eg. when the crew returns after 7 days to sample the wells). If necessary, boring and sampling locations will be adjusted to avoid possible UXO hazards that the sweeps have detected below the surface.

(b) Emergency Medical Technicians (EMT) will be on standby with a van during all drilling for UXO clearance operations. The EMTs and van will be positioned at the entrance to the impact area at the intersection of Wheelock and Pocasseet Sandwich Roads. The sampling crew will have communications

with the EMT and Range Control by portable radio. Range Control will have external communications with off site personnel by installation telephone.

(c) All borehole advancement operations will be carried out in two-foot increments with UXO screening after every two feet of drilling. At the end of each two-foot increment, the drill rods and casings will be removed, and the UXO screening contractor will screen the boring for unexploded ordnances. When the boring is determined to be free of UXOs, the driller will resume advancement of the boring for another two feet. This sequence of drilling and UXO screening will continue until the boring reaches the specified depth of penetration. The expected depth of penetration will be determined by the Huntsville Distric Corps of Engineers. Beyond this depth of penetration, drilling will proceed in a normal fashion until the appropriate depth is reached.

(d) Should an UXO be encountered or a detonation occur, work will immediately stop. The sample team will call by radio to Range Control and deliver a personnel and equipment damage report. If necessary, the standby van and EMTs will evacuate injured personnel.

3.2 *Hazard Analysis of Each Site Work Task*

TASK NAME: DRILLING, SOIL SAMPLING, AND WELL INSTALLATION

Potential Hazards: (Check all that apply to either existing conditions or that result from site operations)

(√) Rotating Machinery
(√) Heat Stress
( ) Cold Stress
(√) Heavy Equipment
(√) Intrusive Activ's (underline)
- Trenching
- Drilling
- Soil Vapor Surv.
- Sampling

(√) Uneven terrain
( ) Trench/excavation collapse
( ) Projectiles
( ) Physical Exertion
(√) Noise (>85 dBA)
( ) Vehicle Traffic
(√) Fire/Explosion (underline)
- Flam. Materials
- Low-lying Areas
- Fuel lines

( ) Work over water (lagoons, streambeds, ravines, bay ocean)
( ) Confined Space
( ) Biological (plants, rodent viruses, marine species, soilborne or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)
( ) Electrical (utilities)
(√) Chemical Exposure
(√) Other (List) - UXO

Control or Protective Measures: (see also Table 4)

(√) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls: _____
( ) SOPs: _____
( ) Other: - UXO Clearance _____
(√) PPE, Level-mod D
(√) Site Control
(√) Air Monitoring
(√) Decontamination

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Initial levels of protection have been assigned for this work task based on the potential risk of exposure. Levels may be upgraded or downgraded depending on monitoring data (see Action Levels, Table 5) and site conditions, as determined by the Site Health and Safety Coordinator (SHSC). Any modification to the levels of PPE below must be noted here and documented with a completed ROC form (Appendix 2).

Level Of Protection: ( ) A ( ) B ( ) C (√) Modified D ( ) D

Respirator: (Level C and above)
( ) SCBA, Airline ( ) Purif. Resp. ( ) Escape Mask
( ) OV/AG Cart. ( ) Other _____

Protective Clothing:	( ) Encap. Suit	(√) Tyvek®	( ) PE Tyvek®
	( ) Saranex	( ) Splash Suit	( ) Other _____
Head/Eye/Ear:	(√) Hard Hat	(√) Safety Glasses	( ) Goggles
	( ) Splash Shield	(√) Ear Plugs/Muffs	( ) Other _____
Gloves: (outer)	(√) Nitrile	( ) Neoprene	( ) PVC
(inner)	(√) Latex	( ) Vinyl	( ) Other _____
Footwear:	(√) Steel-toed Leather	( ) Overboots	
	( ) Steel-toed Rubber	( ) Other _____	

Modifications Permitted: _____

Ã = required PPE; * = modifications permitted; † =in case of upgrade.

TASK NAME: WELL DEVELOPMENT AND GROUND WATER SAMPLING

Potential Hazards: (Check all that apply to either existing conditions or that result from site operations)

( ) Rotating Machinery
(√) Heat Stress
( ) Cold Stress
( ) Heavy Equipment
( ) Intrusive Activ's (underline)
- Trenching
- Drilling
- Soil Vapor Surv.
- Sampling

( ) Uneven terrain
( ) Trench/excavation collapse
( ) Projectiles
(√) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion (underline)
- Flam. Materials
- Low-lying Areas
- Fuel lines

( ) Work over water (lagoons, streambeds, ravines, bay ocean)
( ) Confined Space
( ) Biological (plants, rodent viruses, marine species, soilborne or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)
(√) Electrical (utilities)
(√) Chemical Exposure
(√) Other (List) - UXO

Control or Protective Measures: (see also Table 4)

(√) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls: _____
( ) SOPs: _____
( ) Other: - UXO Clearance_____
_____
_____
(√) PPE, Level __
(√) Site Control
( ) Air Monitoring
(√) Decontamination

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Initial levels of protection have been assigned for this work task based on the potential risk of exposure. Levels may be upgraded or downgraded depending on monitoring data (see Action Levels, Table 5) and site conditions, as determined by the onsite health and safety coordinator (SHSC). Any modification to the levels of PPE below must be noted here and documented with a completed ROC form (Appendix 2).

Level Of Protection:	( ) A ( ) C ( ) B	(√) Modified D ( ) D	
Respirator: (Level C and above)			
	( ) SCBA, Airline	( ) Purif. Resp.	( ) Escape Mask
	( ) OV/AG Cart.	( ) Other Cart. _____	
Protective Clothing:	( ) Encap. Suit	(√) Tyvek®	( ) PE Tyvek®
	( ) Saranex	( ) Splash Suit	( ) Other _____
Head/Eye/Ear:	( ) Hard Hat	(√) Safety Glasses	( ) Goggles
	( ) Splash Shield	( ) Ear Plugs/Muffs	( ) Other_____
Gloves: (outer)	(√) Nitrile	( ) Neoprene	( ) PVC
(inner)	(√) Latex	( ) Vinyl	( ) Other _____
Footwear:	(√) Steel-toed Leather	( ) Overboots	
	( ) Steel-toed Rubber	( ) Other_____	

Modifications Permitted: _____
_____
_____

Ã = required PPE; * = modifications permitted; † =in case of upgrade.

TASK NAME: SURFACE WATER AND SEDIMENT SAMPLING

Potential Hazards: (Check all that apply to either existing conditions or that result from site operations)

( ) Rotating Machinery
(√) Heat Stress
( ) Cold Stress
( ) Heavy Equipment
( ) Intrusive Activ's (underline)
- Trenching
- Drilling
- Soil Vapor Surv.
- Sampling

( ) Uneven terrain
( ) Trench/excavation collapse
( ) Projectiles
(√) Physical Exertion
( ) Noise (>85 dBA)
( ) Vehicle Traffic
( ) Fire/Explosion (underline)
- Flam. Materials
- Low-lying Areas
- Fuel lines

(√) Work over water (lagoons, streambeds, ravines, bay ocean)
( ) Confined Space
( ) Biological (plants, rodent viruses, marine species, soilborne or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)
( ) Electrical (utilities)
(√) Chemical Exposure
( ) Other (List)

Control or Protective Measures: (see also Table 4)

(√) Tailgate Meetings
( ) Operator Training
( ) Engineering Controls: _____
( ) SOPs: _____
( ) Other: - Life jackets if in or over water_____
_____
_____
(√) PPE, Level __
(√) Site Control
( ) Air Monitoring
(√) Decontamination

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Initial levels of protection have been assigned for this work task based on the potential risk of exposure. Levels may be upgraded or downgraded depending on monitoring data (see Action Levels, Table 5) and site conditions, as determined by the Site Health and Safety Coordinator (SHSC). Any modification to the levels of PPE below must be noted here and documented with a completed ROC form (Appendix 2).

Level Of Protection: ( ) A ( ) B ( ) C ( ) D (√) Modified D

Respirator: (Level C and above)
( ) SCBA, Airline ( ) Purif. Resp. ( ) Escape Mask
( ) OV/AG Cart. ( ) Other _____

Protective Clothing: ( ) Encap. Suit (√) Tyvek® ( ) PE Tyvek®
( ) Saranex ( ) Splash Suit ( ) Other _____

Head/Eye/Ear: ( ) Hard Hat (√) Safety Glasses ( ) Goggles
( ) Splash Shield ( ) Ear Plugs/Muffs ( ) Other _____

Gloves: (outer) (√) Nitrile ( ) Neoprene ( ) PVC
(inner) (√) Latex ( ) Vinyl ( ) Other _____

Footwear: ( ) Steel-toed Leather (√) Overboots
( ) Steel-toed Rubber ( ) Other - Chest waders if in water_____

Modifications Permitted: _____
_____

Ã = required PPE; * = modifications permitted; † =in case of upgrade.

3.3 Site Control

(a) Site control and access will be strictly controlled by Camp Edwards Range Control during field operations. During sampling operations in the impact area, Range Control will prevent anyone from entering the impact area. Messages will be relayed by radio from Range Control to the project manager. No one will be allowed to enter the sample site without first receiving permission from the project manager.

(b) Field work of all types during this project will be accomplished only when there are at least two persons at a work site. Because of the nature of this work, there is no need for special internal communications procedures among field personnel. External communications with off site personnel will be by installation telephone, by portable radio, or by messenger. In addition to the special site control measures to be implemented at CS-19, the drilling standing operating procedures attached to this document will be followed by all on site personnel.

(c) The buddy system will be used. Each worker should consider himself as a safety backup to his partner.

(d) Visual contact must be maintained between buddies on site.

(e) Alcoholic beverage intake is prohibited during the work day.

(f) No personnel will be admitted on site without the proper safety equipment.

(g) Contact with contaminated or potentially contaminated surfaces will be avoided. Soiling of protective clothing will be minimized. Workers will avoid getting potentially contaminated soil from gloves on face or into eyes.

(h) Personnel decontamination will be performed to protect workers and off-site personnel from chemical exposure, and to limit the spread of contamination in the study area. Personnel decontamination will consist of cleaning soil from the boots and shoes, removal and bagging of disposable protective clothing, and removal and disposal of gloves. Neoprene gloves will be worn during the decontamination process. No personnel will leave the work area while wearing soiled protective coveralls. Soiled protective clothing will be disposed of as sanitary solid waste.

(i) Equipment decontamination will be performed at each study site. This will consist primarily of scraping soil from augers and downhole drilling equipment. After auger and downhole drilling equipment are initially cleaned in the field, they will be cleaned a second time using high pressure potable water or a steam cleaner. This cleaning will be accomplished prior to the use of equipment at another site/borehole and prior to leaving the installation.

(j) During drilling operations, a fire extinguisher will be available at the drilling site. However, should a fire develop from contact with UXOs, the sample crew will immediately take cover and notify Range Control. THE SAMPLE CREW WILL NOT MAKE ANY ATTEMPT TO EXTINGUISH A FIRE CAUSED BY CONTACT WITH AN UXO.

(k) A First Aid Kit will be available during site activities.

(l) Eating will not be allowed on the investigation sites.

(m) All personnel must comply with established safety procedures and the Drilling Operations SOP (encl). Any staff member who does not comply with safety policy, as established by the Project Manager or Onsite Safety Manger, will be immediately dismissed from the site.

3.4 Emergency Response Plan

(a) Emergency medical assistance may be obtained by contacting Range Control via the installation supplied portable radio. Range control will contact all emergency services. At the start of each day's work, the sample team will assemble in the Range Control office. A daily safety meeting will be held and the sample team will be supplied with a portable radio. The portable radio will be returned to the Range Control office at the close of each day's work. Medical assistance can also be obtained by dialing one of the listed phone numbers from installation telephones.

(i) Hospital - Falmouth Hospital in Falmouth
548-5300

(ii) Coast Guard Dispensary
(on base) 4111
(commercial) 968-4111

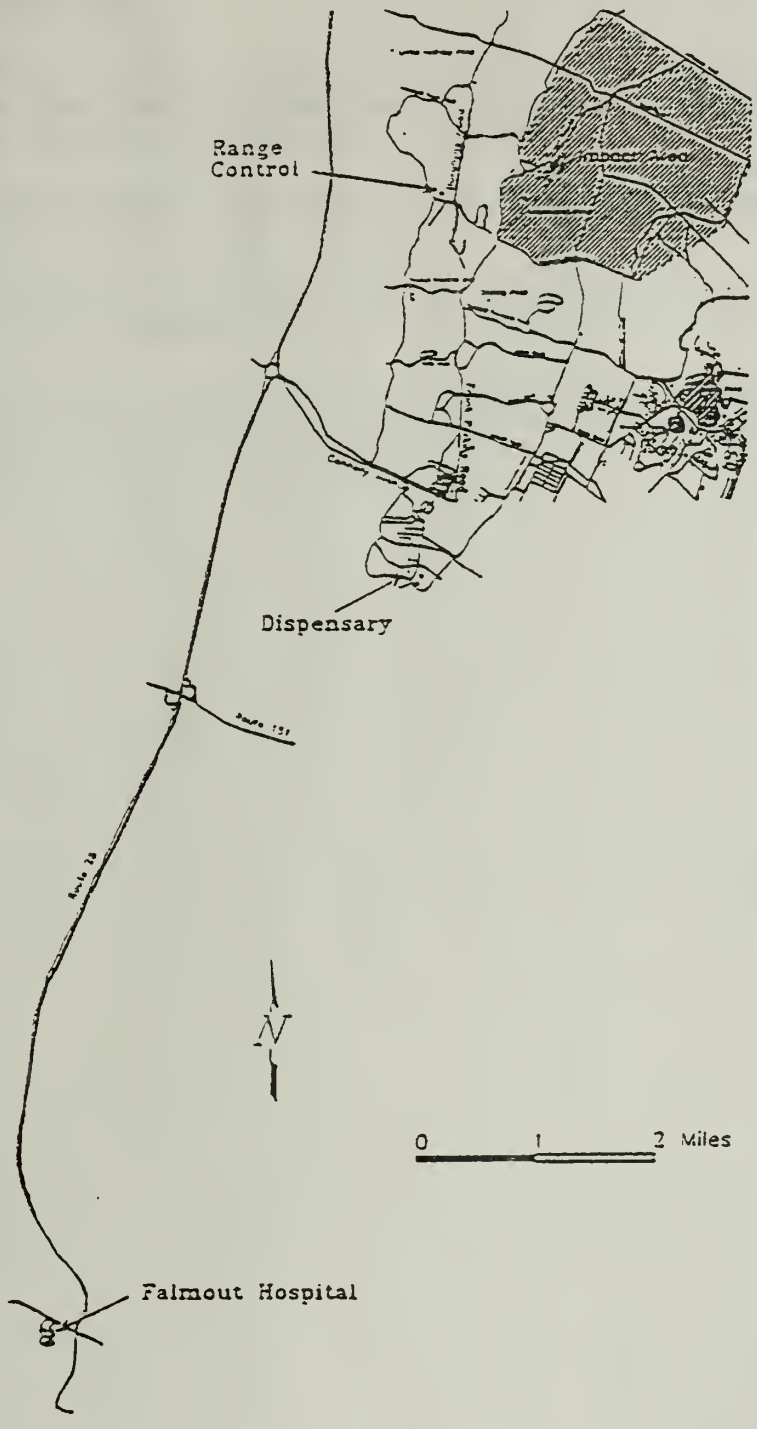
(iii) Range Control
(on base) 5925
(commercial) 968-5925

(b) If a minor injury occurs and the injured person can be safely transported, medical care can be obtained from the standby EMT or the Coast Guard dispensary. If a serious injury occurs, the injured person will be evacuated by ambulance or van, which is staffed by trained Emergency Medical Technicians. During this project, all field crews will have available at least one vehicle which can be used in an emergency to transport injured personnel. The medical care facilities nearest to the work site are:

The Coast Guard Dispensary. EMTs are on duty during working hours and available for treatment of minor injuries.

Falmouth Hospital. The hospital is open 24 hours daily. The Hospital is located approximately 10 miles south of the Camp Edwards main gate.

See Figure 3-2 for the locations of these facilities.



DRAWN ____ DATE	ENGINEERING TECHNOLOGIES ASSOCIATES, INC. ENGINEERS • PLANNERS • SURVEYORS 3468 ELLICOTT CENTER DRIVE - SUITE 101 ELLICOTT CITY, MARYLAND 21043	MMR IMPACT AREA H&S PLAN FIGURE 3-2 FACILITIES LOCATIONS AND HOSPITAL ROUTE
CHECKED ____ DATE		SCALE: NTS | CONTRACT NO.: 92307.012 | DATE: 12/96 | SHEET:
APPROVED ____ DATE		

4.0 REFERENCES

1. ABB Environmental Services, Inc., "Site Assessment, Work Completion Report-Chemical Spill Site In Impact Area" (Study Area CS-19), Massachusetts Military Reservation, Cape Cod, Massachusetts, prepared for Hazardous Waste Remedial Actions Program, November 1992.

2. U.S. EPA Region III Technical Guidance Manual, "Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening" January 1993.

3. EPA Directive Number: OSWER 9355.4-02, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites, 7 September 1989.

4. Memorandum, USAEHA, HSHB-ME-SH, 11 September 1987, subject: Interim Report, Hazardous Waste Study No. 37-26-0165-87, Investigation of Soil Contamination from Propellant Burns, Camp Edwards, Massachusetts, 25-29 June and 14-15 July 1987.

GROUNDWATER PURGING AND SAMPLING SOP
Low-Flow and Standard Method

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to describe the general methodology for collecting groundwater samples in the field using the low-flow purge/sample and standard 3-well volume purge methods.

2.0 SCOPE

This procedure applies to all Jacobs personnel and subcontractors who purge groundwater monitoring wells and collect groundwater samples.

3.0 REFERENCES

1. EPA, 1990. "Procedures to Schedule and Complete Sampling Activities in Cooperation with EPA Region VII Environmental Services Division".
2. EPA, 1991. "Region VII - Environmental Services Division Operations and Quality Assurance Manual".
3. EPA, 1995. "Region I - SOP GW 0001 (Low Flow SOP Draft 1)".

4.0 DEFINITIONS

1. Groundwater: Water in a saturated zone or stratum beneath the surface of land or water.
2. Purging: Operation by which stagnant groundwater standing in a monitoring well is removed to allow replacement by fresh formation groundwater.
3. Custody: Physical control of an object, in this case of an environmental sample.
4. Sample Custodian: Refers to the individuals who, sequentially over a period of time, have physical custody of the sample.
5. Chain-of-custody record: Documentation of the chain-of-custody showing times, dates, and names of the individuals relinquishing and receiving the samples identified on the record.

5.0 GENERAL

To obtain representative groundwater samples, disturbances of the natural column should be kept to a minimum by minimizing the turbidity of the well while maximizing the

representativeness of the sample. The reasoning behind the use of low-flow pumps to purge and sample monitoring wells is that these pumps minimize physical disturbance (turbulence) at the sampling point and chemical changes (aeration) in the medium. For the purposes of this SOP, "low-flow pumps" are defined as either dedicated bladder pumps or variable speed submersible pumps. Practical operational flow rates for these sampling devices range from 0.1 L/min to 30 L/min. Only if low-flow procedures are not possible or practical will the standard 3-well volume purge and sampling procedures be used.

6.0 RESPONSIBILITIES

The *Project Manager* shall assure that the sampling procedures will obtain samples that represent the environment being investigated. Trace levels of contaminants from external sources will be eliminated through the use of good sampling techniques and proper selection of sampling equipment.

The *Field Team Leader* (FTL) shall ensure that specified sampling procedures are followed, samples are labeled, handled and controlled correctly, and strict chain-of-custody is initiated, maintained, and documented.

Jacobs field or subcontract personnel responsible for collecting groundwater samples will do so in accordance with this SOP.

7.0 PROCEDURE

7.1 Supplies and Equipment

7.1.1 Major Equipment Items

- Variable-rate submersible pump/hose assembly with control unit, electrical generator, and extension cord.
- Gasoline and oil (for generator).
- Soap water containers.
- Potable water containers.
- Deionized water containers.
- Methanol solution containers.
- Purge water drums.

7.1.2 Equipment Support Items

- Drum liners.
- Trash bags.
- Decontamination tub.
- Thirsty-mate hand pump.
- Low phosphate detergent, such as Alconox or Liquinox.

- Gloves (nitrile)
- 5-gallon bucket.
- Folding table.
- Folding chairs.
- Kim wipes/towels.
- Calculator.
- Stopwatch.

7.1.3 Sampling Supplies

- Written description of wells including I.D. numbers, locations, elevations and well construction details.
- Well keys.
- Sample containers w/ foam holders.
  - VOA-clear w/preservatives.
  - EDB-amber w/o preservatives.
  - Inorganic - plastic w/ preservatives.
  - Others - as specified.
- Chain-of-Custody forms.
- Sample labels.
- 0.45 micron filters and pump (for dissolved metals sampling).
- Field Data Forms.
- pH paper.
- Ice chest.
- Ice for sample preservation.
- Zip-lock bags.
- Field logbook.
- Pen and waterproof permanent marker.

7.1.4 Monitoring Equipment

- Electronic water level indicator.
- YSI Model Water Quality Checker w/ flow-through cell or comparible water quality sampling device (at a minimum, pH, temperature, specific conductance, turbidity probes, and dissolved oxygen) ORP probes are optional based on project specific objectives.
- Photoionization Detector.

7.1.5 Health & Safety Items

- First aid kit and emergency eye-wash kit.
- Fire Extinguisher.
- MSDS/Emergency information packet (route to hospital/ phone contacts)
- Drinking water cooler.

- Field Radio (optional).

7.2 General Equipment Decontamination

Before purging or sampling, all pumps and hoses, water level measurement devices, wa quality probes, and other sampling equipment shall be decontaminated. If new dedicat equipment is used, it should be thoroughly decontaminated and rinsed with distilled wa before placement in the well. Mobile decontamination supplies shall be used so th equipment can be decontaminated in the field. Each piece of purging or sampl equipment shall be decontaminated prior to and between sampling operations and we Depending on site conditions, the decontamination solutions shall be replaced with cle solutions between wells. Used solutions shall be placed in the container with purged w water for disposal. Purge water and decontamination solutions shall be handled a disposed of as outlined in the Quality Assurance Project Plan (QAPP) or Investigati Derived Materials Management Plan (IDMMP). The procedures specified in the Jacob SOP MMR TECH-036 Equipment Decontamination or the Health and Safety Plan (HS shall be followed for decontamination of field equipment, purging, sampling, and f personnel decontamination.

7.3 Measurement of Water Quality Parameters and Instrument Calibration

Electronic equipment used during purging and sampling includes a photoionization detect (PID), a water level indicator, and a water quality measurement device meter with attache temperature, pH, specific conductance, and turbidity probes. Dissolved oxygen, ar oxidation/reduction potential (ORP) probes will be used in a Task specific basis. Befo going into the field, the FTL shall verify that these instruments are operating properly. Eac probe of the water quality measuring device must be calibrated prior to its use and checke at the beginning and end of each day for maintenance of calibration. Calibration procedure shall follow manufacturer's instructions. The PID will be calibrated daily using standa calibration gas as specified by the manufacturer. If instrument readings become erra during normal operations, recalibration will be conducted. Operating instructions will b followed for all instruments.

Person(s) responsible for calibrating equipment shall complete the equipment specif checklist including identification of calibration standards and affixing their signature to th checklist form.

Field measurements for temperature, pH, turbidity, specific conductance, dissolved oxyger and ORP shall be made in accordance with Jacobs' SOPs and the manufacturer instructions. Calibration information will be recorded following each event on th instrument's Equipment Calibration Log and in the field logbooks. Task- or site-specifi equipment or calibration procedures, if required by the QAPP, shall be performed accordin to the appropriate procedures.

7.4 Well Purging

The purpose of well purging is to remove stagnant water from the well and obtain a representative water sample from the geologic formation being sampled while minimizing disturbance of the water column during sample collection. Using the low-flow purging methodology, the well shall be purged until a minimum of two screen volumes have been removed and field parameters (pH, temperature, turbidity, and electrical conductance, and dissolved oxygen) have stabilized or until the well is pumped or bailed dry. The well shall be sampled immediately following purging without moving or adjusting the position of the pump. If the well is purged dry, it will be sampled immediately following well recovery. Evacuated well water shall be managed as outlined in the IDMMP. The purge water will be contained for proper disposal. Necessary precautions shall be taken to prevent spilling of potentially contaminated water. If it is permissible, purge water may be discharged upon the ground away from the monitoring well. In most instances, however, the water will need to be containerized and treated prior to discharge.

For standard low-flow well purging, the following procedures shall be performed at each well:

- Don PPE as specified in the HSP.
- The condition of the outer well casing, concrete well pad, protective posts (if present), and any unusual conditions of the area around the well shall be noted in the field logbook. The well may also be photographed.
- Using the PID, check the area around the well for VOC vapors and record this reading on the field data form or field logbook (PID background reading).
- Open the well cap and immediately check for VOC vapors in the well casing. Record this reading on the field data form or field notebook.
- If necessary during purging/sampling, appropriate readings shall be taken in the breathing zone with air monitoring equipment (PID) according to the HSP.
- Note if the reference point (measuring point) on the well is present. This is usually an indelible mark or V-notch cut. If this point is missing, make one on the north side of the well casing.
- The depth of the static water level shall be measured with a water level indicator (to nearest 0.01 foot) and recorded from the measuring point on the well casing. Record this information.
- If the total depth of the well is known, it is not recommended to measure this until purging/sampling is complete due to unnecessary agitation of silt on the well bottom. If the total depth of well is not known, it shall be measured from the same measuring point on the casing with a water level indicator and recorded. It is critical that the distance between the water sensor and the end of the water level indicator probe be measured independently and added to each total depth measurement.

- Slowly lower the pump into the well casing to a point in the middle of the screened interval (generally 2.5 feet above the bottom of the well). If possible, do not "tag" the bottom of the well since it causes unnecessary agitation of silt. If this is not possible, lower the pump very slowly and carefully to the bottom, then pull it back slowly to position the pump within the middle of the well screen. If the bottom of the well was tagged, wait at least 10 minutes before beginning to purge to allow suspended material to settle to the bottom of the well again. Reinsert the water level indicator to monitor water levels during purging.
- Start the pump. As soon as water is discharging, adjust the pump speed to its minimum capacity without causing drawdown. During purging and sampling, the maximum allowable drawdown is 0.3 ft. Additionally, to assist in quicker turbidity stabilization, the target equilibrium pumping rate should be 0.1 to 0.2 liters per minute.
- Using a stopwatch and some type of graduated cylinder, measure the pumping rate. Monitor the water level, pumping rate, cumulative withdrawal, and field parameters every 5 minutes and/or per well volume. In most instances, field parameters include temperature, pH, turbidity, specific conductance, dissolved oxygen, and/or oxidation/reduction potential will be monitored. Check the site-specific SAP for applicable parameters. In-situ measurements are required when obtaining field parameters.
- As a minimum, two screened interval volumes of water must be purged. The volume of water in the well screened interval shall be calculated in gallons based on the length of the screen and the screen diameter (see below for calculation of volumes). If the well has a filter pack, the screen volume plus the filter pack void volume shall be used to calculate the required unit volume to be evacuated.

The well screen unit volume (gallons) will be calculated using the following equation:

$$\text{Well Screen Volume} = \frac{\Pi}{4}\Phi^2_{in.}(\Delta h_{ft.})\ (7.48\ gallons/ft.^3)$$

$$= 0.041\,(\Phi_{in.})^2\,(\Delta h_{ft.})$$

where $\Phi_{in.}$ = well casing diameter in inches and

$\Delta h_{ft.}$ = length of well screened interval

0.041 = conversion factor

The Saturated Filter Pack Unit Volume will be calculated using the following equation:

$$\text{Saturated Filter Pack Unit Volume} = \frac{\Pi}{4}\left[(\Phi_{1_{ft.}})^2 - (\Phi_{2_{ft.}})^2\right](\Delta h_{ft.})(n_e)(7.48\ gallons/ft.^3)$$

$$= 0.041\left[(\Phi_{1_{in.}})^2 - (\Phi_{2_{in.}})^2\right](\Delta h_{ft.})(n_e)$$

where $\Phi_{1_{in.}}$ = well boring diameter in inches

$\Phi_{2_{in.}}$ = well casing diameter in inches

$\Delta h_{ft.}$ = length of well screened interval

n_e = effective porosity of gravel pack (dimensionless)

0.041 = a conversion factor

Example: For 11" diameter borehole, 4" casing diameter, filter pack porosity = .30, screened interval = 10 feet

Saturated Filter Pack Unit Volume = 0.041 (11^2 - 4^2) (10) (.30)
= 12.9 gal

Casing Unit Volume = 0.041 $(4)^2$ (10) = 6.6 gal

Total Unit Volume = Saturated Filter Pack Volume + Casing Unit Volume = 19.5 gal

2 Unit Volumes = 39 gal

Purging is complete only when all required field parameters have stabilized (temperature, pH, specific conductance, turbidity, and dissolved oxygen) and a minimum of two screen length volumes have been purged. Stabilization is achieved when pH values are within ±0.1 pH unit, temperature within ±3%, conductivity is within ±3%, dissolved oxygen within ±10%, and turbidity is within ±10%. Turbidity should generally remain below 5 nephelometric turbidity units (NTU) at completion of purging. The Project Manager and/or the Sampling Team Leader has the responsibility of determining if redevelopment of the monitor well is necessary and appropriate. If, after 4 hours of purging, stabilization has not been achieved, current readings will be recorded and purging will be considered complete. Sampling can now begin.

When a monitor well is pumped dry before water stabilization criteria has been achieved, the sample shall be collected as soon as a sufficient amount of fluid has reentered the well.

In some instances, the standard procedure outlined above cannot be followed. Most commonly, this occurs when either well drawdown cannot be maintained at less than 0.3 feet, or when the well screened interval is deeper than the length of the pump hose, resulting in the pump not being placed within the screened interval. When these conditions occur, the following modifications are made:

- For wells where the pump cannot reach the middle of the screened interval, the pump will be placed as deep within the well as possible.
- As a minimum, three well volumes of water must be purged. The volume of water in the well shall be calculated in gallons based on feet of water and casing diameter (see below for calculation of volumes). If the well has a filter pack, the well volume plus the filter pack void volume shall be used to calculate the required unit volume to be evacuated.

The casing unit volume (gal) will be calculated using the following equation:

$$\text{Casing Unit Volume} = \frac{\Pi}{4}\Phi_{ft.}^2\,(\Delta h_{ft.})\,(7.48\ gallons/ft.^3)$$

$$= 0.041\,(\Phi_{in.})^2\,(\Delta h_{ft.})$$

where $\Phi_{in.}$ = well casing diameter in inches and

$\Delta h_{ft.}$ = (well depth (feet) - depth to water (feet))

0.041 = conversion factor

The Saturated Filter Pack Unit Volume will be calculated using the following equation:

$$\text{Saturated Filter Pack Unit Volume} = \frac{\Pi}{4}[(\Phi_{1_{ft.}})^2-(\Phi_{2_{ft.}})^2](\Delta h_{ft.})(n_e)(7.48\,gallons/ft.^3)$$

$$= 0.041\,[(\Phi_{1_{in.}})^2-(\Phi_{2_{in.}})^2](\Delta h_{ft.})(n_e)$$

where $\Phi_{1_{in.}}$ = well boring diameter in inches

$\Phi_{2_{in.}}$ = well casing diameter in inches

$\Delta h_{ft.}$ = (well depth (feet) - depth to water (feet))

n_e = effective porosity of gravel pack (dimensionless)

0.041 = a conversion factor

Example: For 11" diameter borehole, 4" casing diameter, filter pack porosity = .30, well depth = 50' and depth to water = 20'.

Saturated Filter Pack Unit Volume = $0.041\ (11^2 - 4^2)\ (50\text{-}20)\ (.30)$
= 38.7 gal

Casing Unit Volume = $0.041\ (4)^2\ (50\text{-}20)$ = 19.7 gal

Total Unit Volume = Saturated Filter Pack Volume + Casing Unit Volume = 19.5 gal

3 Well Volumes = 175.2 gal

Once this volume of groundwater has been removed, purging is completed once field parameters have stabilized. Sampling can now begin.

7.5 Sample Collection

Using low-flow sampling procedures, samples for chemical analysis shall be collected immediately following purging without disturbing the pump. For slow recovering wells or wells that were purged dry, the sample shall be collected immediately after a sufficient volume is available. The water quality samples shall be taken from within the well screen interval. The following sampling procedure shall used at each well:

- Immediately following low-flow purging, the pump will be used to collect the groundwater sample. The pump should not be moved between purging and sampling.
- Identification labels for sample bottles shall be filled out for each well.
- The individual sample bottles should be filled in the order given below:

  Volatile organic compounds (VOCs)
  Ethylene dibromide (EDB)
  Semi-volatiles organic compounds (SVOCs)

Metals (Inorganics)
Inorganic anions
Other parameters
Field test parameters (pH, specific conductance and temperature)
VOC sample vials should be completely filled so the water forms a convex meniscus at the top, then capped so that no air space exists in the vial. Turn the vial over and tap it to check for bubbles in the vial which indicate air space. If air bubbles are observed in the sample vial, discard the vial and collect another sample.
Fill containers for SVOCs, inorganics, inorganic anions, and other parameters analyses almost full. Samples shall be preserved and managed as detailed in the site-specific QAPjP. Time of sampling shall be recorded. When collecting samples using preservatives, the pH should be periodically checked. This is best accomplished by filling an extra vial during collection, ensuring it is not overfilled, then using pH strips to check that the sample is at or below the maximum pH allowed. It is never permissible to insert pH strips into a sample container.

- After the samples have been collected, they should immediately be placed in an ice-filled cooler until relinquished to the on-site laboratory or shipped to the appropriate fixed-based lab.
- Before decontamination, the well cap shall be replaced and locked.
- Prior to leaving the site, field documentation shall be completed, including the chain-of-custody.

7.6 Decontamination

Proper decontamination (decon) between wells is essential for the integrity of samples. The following steps shall be adhered to during decontamination:

- Potable water should be pumped through the pump/hose assemble for a period of 2-3 minutes to remove any remaining well water. This will be discharged into the purge water drum.
- Non-phosphate detergent such as Liquinox shall be flushed through the pump and hose. This will be recycled through the system (i.e. discharged back into the soap solution container) for 5 minutes.
- Flush system with potable water to removed all detergent solution from the system.
- A methanol solution (composed of 80% potable water and 20% pesticide-grade methanol) will be pumped through the system. In wells with a history of little or no volatile contamination (usually less than 10 ug/L), the flush will occur for 2-3 minutes and the solution will discharged into the purge water container. For wells with significant contamination (> 10 ug/L), this solution will be recycled for up to 15 minutes to increase the contact time between the methanol solution and

provides a copy to the sampling team to document their receipt of the split sampl
split sample collected by the sampling team is preserved, packaged and submit
analysis in the same manner as the other characteristic samples in accordance w
site-specific QAPP.

7.7.5 Duplicate Samples

Duplicate samples are collected to assess the total precision of field and labora
components of the field investigation. Duplicate samples are similar to split samples, ex
that duplicate samples also include environmental variability as the result of the collectio
two independent samples. To maximize the information available in assessing to
precision, duplicate samples should be collected from the locations suspected of the highe
contaminant concentrations. Field measurements, visual observations, and past samplir
results and information on site operations may be used to select appropriate locations fo
duplicate analyses.

Duplicate samples are collected by repeating the entire sampling process immediately after the original sample has been collected.

This sample is to be collected immediately following collection of the original sample. The duplicate sample shall be preserved and handled in the same manner as the primary sample and assigned a sample number, stored in the same iced cooler, and shipped to the laboratory with the other samples. Whenever possible, the sample identification numbers for the characteristic sample and its duplicate shall be independent such that the receiving laboratory is not able to distinguish which samples are duplicates prior to analysis. This minimizes the potential for laboratory bias.

7.7.6 Matrix Spikes and Matrix Spike Duplicates

An extra volume of sample media may be collected during the sampling event for performance of matrix spike/matrix spike duplicates by the laboratory to assess laboratory accuracy and precision. The samples shall be collected in the same manner as duplicate samples and are labeled extra volume samples for matrix spike/matrix spike duplicates. The sample volumes required for these analyses shall be coordinated with the laboratory and described in the site-specific QAPP. Following shipment of the samples to the laboratory, the laboratory shall prepare matrix spike (MS) and matrix spike duplicate (MSD) samples and calculate the percent recovery and relative percent difference in concentrations between the samples.

7.7.7 Performance Evaluation (PE) or Audit Spike Samples

Performance evaluation, or pre-spiked audit samples, may be used to assess laboratory extraction efficiency and accuracy in constituent identification and quantification. These samples are helpful in assessing potential bias of analytical methods. They are also

commonly used to evaluate the accuracy of the lab procedures. These samples are generally prepared by an independent laboratory and shipped in pre-sealed containers to the field to be included with the samples sent to the laboratory performing the analysis of site samples. The analytes of interest and corresponding analyte concentrations for the spike samples shall be specified in the request to the independent laboratory providing the samples in accordance with the site-specific QAPP. These samples shall be assigned an identification number, stored in an iced cooler, and shipped blind to the laboratory with the other samples.

7.7.8 Background Samples

Background groundwater samples are used to assess the range of concentrations in the vicinity of the site which are not the result of site activities. These samples should be taken from areas not anticipated to have been impacted by historical site operations (i.e., away from the contaminant source areas and hydraulically upgradient based on the groundwater flow duration).

The background samples should be collected at the locations and depths specified in the site-specific QAPP and/or SAP. At a minimum, background groundwater samples shall be collected for each aquifer zone sampled. Where possible, the background wells shall be constructed and developed in the same manner as the site monitoring wells.

7.8 Sample Identification, Handling, and Documentation

Samples shall be identified, handled, and recorded as described in this SOP and in accordance with standard sample handling protocols indicated in the site-specific QAPjP.

7.9 Documentation

Field notes shall be kept in a bound field logbook. The following information shall be recorded using waterproof ink:

- Names of sampling personnel
- Weather conditions
- Project number and project title
- Chain-of-custody numbers
- Location and well number
- Date and time of sampling
- Condition of the well
- Decontamination information
- Initial and final static water level, total well depth, well stick-up, and measuring point
- Calculations (e.g., calculation of purged volume)
- Field forms for well purging and water quality information

provides a copy to the sampling team to document their receipt of the split sample. The split sample collected by the sampling team is preserved, packaged and submitted for analysis in the same manner as the other characteristic samples in accordance with the site-specific QAPP.

7.7.5 Duplicate Samples

Duplicate samples are collected to assess the total precision of field and laboratory components of the field investigation. Duplicate samples are similar to split samples, except that duplicate samples also include environmental variability as the result of the collection of two independent samples. To maximize the information available in assessing total precision, duplicate samples should be collected from the locations suspected of the highest contaminant concentrations. Field measurements, visual observations, and past sampling results and information on site operations may be used to select appropriate locations for duplicate analyses.

Duplicate samples are collected by repeating the entire sampling process immediately after the original sample has been collected.

This sample is to be collected immediately following collection of the original sample. The duplicate sample shall be preserved and handled in the same manner as the primary sample and assigned a sample number, stored in the same iced cooler, and shipped to the laboratory with the other samples. Whenever possible, the sample identification numbers for the characteristic sample and its duplicate shall be independent such that the receiving laboratory is not able to distinguish which samples are duplicates prior to analysis. This minimizes the potential for laboratory bias.

7.7.6 Matrix Spikes and Matrix Spike Duplicates

An extra volume of sample media may be collected during the sampling event for performance of matrix spike/matrix spike duplicates by the laboratory to assess laboratory accuracy and precision. The samples shall be collected in the same manner as duplicate samples and are labeled extra volume samples for matrix spike/matrix spike duplicates. The sample volumes required for these analyses shall be coordinated with the laboratory and described in the site-specific QAPP. Following shipment of the samples to the laboratory, the laboratory shall prepare matrix spike (MS) and matrix spike duplicate (MSD) samples and calculate the percent recovery and relative percent difference in concentrations between the samples.

7.7.7 Performance Evaluation (PE) or Audit Spike Samples

Performance evaluation, or pre-spiked audit samples, may be used to assess laboratory extraction efficiency and accuracy in constituent identification and quantification. These samples are helpful in assessing potential bias of analytical methods. They are also

commonly used to evaluate the accuracy of the lab procedures. These samples are generally prepared by an independent laboratory and shipped in pre-sealed containers to the field to be included with the samples sent to the laboratory performing the analysis of site samples. The analytes of interest and corresponding analyte concentrations for the spike samples shall be specified in the request to the independent laboratory providing the samples in accordance with the site-specific QAPP. These samples shall be assigned an identification number, stored in an iced cooler, and shipped blind to the laboratory with the other samples.

7.7.8 Background Samples

Background groundwater samples are used to assess the range of concentrations in the vicinity of the site which are not the result of site activities. These samples should be taken from areas not anticipated to have been impacted by historical site operations (i.e., away from the contaminant source areas and hydraulically upgradient based on the groundwater flow duration).

The background samples should be collected at the locations and depths specified in the site-specific QAPP and/or SAP. At a minimum, background groundwater samples shall be collected for each aquifer zone sampled. Where possible, the background wells shall be constructed and developed in the same manner as the site monitoring wells.

7.8 Sample Identification, Handling, and Documentation

Samples shall be identified, handled, and recorded as described in this SOP and in accordance with standard sample handling protocols indicated in the site-specific QAPjP.

7.9 Documentation

Field notes shall be kept in a bound field logbook. The following information shall be recorded using waterproof ink:

- Names of sampling personnel
- Weather conditions
- Project number and project title
- Chain-of-custody numbers
- Location and well number
- Date and time of sampling
- Condition of the well
- Decontamination information
- Initial and final static water level, total well depth, well stick-up, and measuring point
- Calculations (e.g., calculation of purged volume)
- Field forms for well purging and water quality information

- Analyses that shall be performed by the laboratory
- Equipment calibration information
- Person performing sampling
- Method of purging
- Volume of water purged before sampling
- Purge start/stop times
- Pumping rate (if applicable)
- Field parameter measurements during purging
- Sample volume, number, and container types
- Method of sample collection
- Sample cooler shipping document number
- Sample preservation
- Photo-documentation
- QA/QC samples collected
- Irregularities or problems

8.0 Attachments

Attachment A - Standard Potentials Reference Sheet
Attachment B - Standard Buffer pH Values at Various Temperatures
Attachment C - Bailed Well Data Sheet
Attachment D - Pumped Well Data Sheet

Reviewed by: James M. McNay 7/24/96
Southern Region Quality Manager

Approved by: Steven Green for T. Hayes 7/24/96
Program Manager, Plume Response Program

ATTACHMENT A

STANDARD POTENTIALS OF CALOMEL AND SILVER-SILVER CHLORIDE ELECTRODES (IN MILLIVOLTS)

T°C	$E°_c$	E_s	E_e (3N KCl)	E_e (3.5N KCl)	E_e (sat KCl) (4.16N at 25°C)
0	274	234	262	–	260
5	273	234	261	–	257
10	272	231	260	256	254
15	271	229	259	254	251
20	270	226	257	252	248
25	268	222	255	250	244
30	267	219	253	248	241

For calomel reference

$$Eh = E_{measured} + E_c$$

For silver-silver chloride reference

$$Eh = E_{measured} + E_e + (E°_s - E°_c)$$

Zobell Solution

$$Eh_{Zobell} = 0.429 + 0.0024\ (25-T)$$

For calomel reference

$$E_{measured} = 0.185 + 0.00164\ (25-T)$$

For silver chloride reference

$$E_{measured} = 0.231 + 0.0013\ (25-T)$$

Where T is in degrees centigrade.

Standard Operating Procedure
Field Soil Screening

Equipment

1. one (1) four-ounce laboratory cleaned glass sample collection jar for each five feet of
2. One (1) field note book
3. One (1) geologic log
4. One (1) Flame Ionization Detector
5. Aluminum foils as needed
6. One (1) stainless steel trowel
7. Sample labels as needed
8. A well heated room or vehicle to allow the screening samples to equilibrate to approximately 70° F

The purpose of field screening samples are to select samples for laboratory analysis and to be used as an indication of possible volatile organic compound contamination. Soil materials will be sampled by means of hollow stem auger borings. Continuous split-barrel dry core will be the preferred sampling method. Soil sample will be collected at appropriate horizons from each borehole for laboratory analysis. Soil samples will be taken for field screening observations at three foot depth intervals, or as determined by the field geologist on the basis of the soil characteristics. The selection of the sample intervals which are most likely to be contaminated will be selected by the field geologist on the basis of soil characteristic and field indications of possible contamination. Separate samples will be collected for field screening and laboratory analysis. A sample collection log will be completed for each soil sample.

Soil samples for volatile organic compound field screening will be expeditiously removed from the soil core and packed into a four-ounce laboratory cleaned glass jar to minimize the loss of volatile compounds. The sample should be collected using a stainless steel trowel. The trowel will be used to collect a composite sample from at least three locations along the soil core. The soil should fill approximately three-fourths of the sample jar. No attempt should be made to mix the composite sample to minimize the loss of volatiles from the sample. A discrete sample from zones exhibiting strong indication of contamination may be collected at the discretion of the field geologist. The field screening sample jar will then be covered by using a small sheet of aluminum foil, and then capped with an air tight lid. The lid should be tightened sufficiently to minimize the escape of volatile during the equilibration time. The following information will be recorded in the field notebook by the field geologist or his designated technician:

- Boring and sample designation
- Name of the sampler
- Time and date of sample collection
- Soil interval where the sample was collected
- Field indications of contamination, if any. These will include, but are not limited to FID/PID readings taken over the core, any odor, or discoloration.
- Soil type and brief description
- Approximate outdoor temperature

Each field screening sample jar will be affixed with a label containing the following information:

- Boring and sample designation
- Name of the sampler
- Time and date of sample collection
- Soil interval where the sample was collected

The soil screening sample will be allowed to equilibrate to ambient room temperature. The time require for temperature equilibration will vary depending on the soil characteristics and the outside temperature. Approximately 15 minutes should be allowed for equilibration during normal working conditions. Colder outside temperatures will require additional time. The field screening sample will then be screened for the presence of volatile organic compounds using a portable flame ionization detector (FID). The calibration procedure in the instrument operation manual will be strictly followed. The FID will be calibrated to two iso-butylene standards. The time and calibration results will be recorded in the field note book by the person performing the calibration.

After the field screening sampled have reached ambient room temperature (approximately 70°F), the lid will be removed from the sample jar, taking care not to damage the aluminum foil seal. After the lid has been removed, the tip of the FID will be forced through the aluminum foil seal, being careful not to let the tip come into contact with the soil. The volatile organic concentration will be read and the highest reading recorded in the field log book along with the time that the sample was screened. The volatile organic concentration shall be included in the geologic log for the soil boring. No detections will also be recorded in the geologic log when the concentration of organic volatile compounds are less then the detection limit of the FID.

After field screening of the sample has been completed, the remaining soil should be returned to the original soil boring and the soil placed upon the waste pile for disposal as investigation derived waste (IDW).

MASSACHUSETTS MILITARY RESERVATION

POLLUTION PREVENTION PLAN

14 March 1997

TRAINING RANGE AND IMPACT AREA
POLLUTION PREVENTION PLAN

INTRODUCTION

This Pollution Prevention Plan covers the actions and activities surrounding the central impact area of the Massachusetts Military Reservation (MMR) which includes the buffer zone and small arms ranges . The scope of this document is not to conflict with other pollution prevention or spill prevention plans for MMR. Measures or programs found in this document were developed specifically for MMR and are not to be considered as standard procedures for other military installations. The reduction and subsequent elimination of pollution is the National Guards top environmental priority. Source reduction is considered to be the best long term and cost effective solution for pollution prevention.

PURPOSE

The purpose of this pollution prevention plan is to provide:

- Methods to identify opportunities for reducing the volume of hazardous material used at MMR.
- Determine procedures which can be implemented in future MMR pollution prevention projects.
- Implement appropriate best management practices to control the discharge of pollutants to air and water.

BACKGROUND AND ACTIVITY DESCRIPTION OF THE MMR IMPACT AREA

The MMR is an approximately 22,000 acre facility located on the western end of Cape Cod, MA. Approximately 14,000 acres of MMR constitutes the training area and impact area. The central impact area is approximately 2,200 acres in size. Military and law enforcement training has been conducted in the training/impact area since the mid-1940's. This has included small arms firing from 19 ranges, artillery and mortar firing, and demolition training at 2 demolition ranges. An average of 1.5 million rounds of small arms ammunition has been fired over the last three years. Over the same period an average of 5,250 rounds of artillery and mortar ammunition have been fired. Of this figure , 3,846 rounds have been Low -cost Indirect Training Rounds (LITR). The LITR artillery rounds do not contain explosives or hazardous materials but produce a small puff of

smoke to indicate where they land. Use of LITR at MMR has increased from 363 in 1994 to 2,959 in 1996 resulting in no high explosive artillery use in 1996.

POLLUTION IMPLEMENTATION PLAN

This plan addresses two functional areas. The first area is "operational actions" that will be taken immediately to lessen the amount of firing certain types of ammunition with hazardous components (demolition training is temporarily suspended) and inactivation of certain ranges. The second area is focused on "mitigation" of the potential for lead migration to groundwater at the small arms training ranges. These measures will include installation of water barriers on the berms, lead extraction from the berm soil and demonstration or transfer of new small arms range environmental technologies where appropriate.

POLLUTION PREVENTION - OPERATIONAL ACTIONS

A. REDUCTION OF ACTIVE SMALL ARMS RANGES.

There are 20 training ranges which fire from around the perimeter of the impact area. Firing will be suspended at seven ranges. They are Ranges D, K , J, N. O, P, U. Once mitigation measures have taken place to remove lead from the impact berms, the suspended ranges will be used only in the event of mobilization.

B. CHANGE TYPE OF AMMUNITION FOR INDIRECT FIRE WEAPONS

The National Guard is actively pursuing ammunition for indirect fire weapons that can be used at MMR. In the mid-1980's , 155mm artillery high explosive ammunition was transitioned to the LITR, which does not contain explosives or hazardous material. Use of high explosive artillery ammunition is no longer allowed at MMR. Currently the National Guard is seeking a replacement for the high explosive ammunition used in mortars. Our research shows that there are alternatives available for the 81mm and 120mm mortars known as the Short Range Training Round (SRTR) which contain no explosives or hazardous materials. As soon as ammunition allocations can be adjusted MMR will request this SRTR ammunition. The 60mm and 4.2in mortars do not have alternatives available at this time.

POLLUTION PREVENTION - MITIGATION ACTIONS, SMALL ARMS RANGES

A. COVER EXISTING BERMS WITH WATER IMPERMIABLE MATERIAL

The majority of the expended small arms munitions are located in the backstop berms of the small arms ranges. This is also the location where we expect to find concentrations of lead. The only way components of the expended munitions can travel downward through the soil mantle is through water transport. The National Guard will install flexible membrane liners similar to landfill caps over all suitable backstop areas within 45 days as a temporary

measure. Approximately 11.3 acres will be covered on small arms ranges with berms. Mobilization asset ranges will remain covered until lead removal operations are completed. Berms of active ranges will be covered so that the liner can be temporarily rolled back during range firing and then replaced.

B. REMOVAL OF EXPENDED MUNITIONS

A variety of technologies exist to remove expended lead munitions from soils. In order to ensure the maximum amount of munitions is removed in the most efficient manner, bench testing of the MMR soils and its properties is required. This will take approximately 4-6 months. Based on those results, soil sifting operations will commence within 6-9 months to remove and recycle bulk quantities of expended munitions and introduce soil modifiers to minimize bullet corrosion and lead migration.

C. RANGE IMPROVEMENT, TECHNOLOGY TRANSFER

Implement within 18-24 months, new small arms range environmental technologies. Technologies available for implementation at MMR with 18-24 months will include:

1. Non-Toxic ammunition (lead free standard combat ammunition is under development for several caliber's and will be used at MMR as soon as it goes into standard production)

2. Bullet Traps/SACON (capture bullets before they enter the environment). This technology will be employed on ranges where lead is most concentrated and where the traps/SACON will capture the vast majority of bullets fired.

3. Operation and Maintenance manual for the ranges will be updated to reflect the provisions contained in this plan once it is approved.

MASSACHUSETTS MILITARY RESERVATION

PUBLIC INVOLVEMENT PLAN

14 March 1997

Public Involvement Plan

National Guard Bureau
and
Massachusetts Army National Guard
Communication Strategy

Massachusetts Military Reservation

March 13, 1997

Developed by:

National Guard Bureau
Alexandria, Virginia

and

Massachusetts Army National Guard
Camp Edwards, Massachusetts

in coordination with:

U.S. Environmental Protection Agency, Region 1

Contents

1.0 Introduction 1

2.0 Purpose and Objectives 2

3.0 Ongoing Studies, Projects, and Issues 3

3.1 Description of the Impact Area Groundwater Study 3
3.1.1 Focus 3
3.1.2 Approach 3
3.1.3 Public Participation 4
3.1.4 Schedule 5

3.2 Description of the MMR EIS/EIR 6
3.2.1 Purpose and Need 7
3.2.2 Public Participation 7
3.2.3 Supplemental Draft EIS/EIR 8

3.3 Description of the Range Maintenance Project 8
3.3.1 MMR Actions 8
3.3.2 Public Participation 9

3.4 Description of the EPA Administrative Order 9
3.4.1 Scope of Work 9
3.4.2 Public Involvement 10

4.0 Principles of Public Dialogue 12

4.1 Cardinal Rules of Risk Communication 12

5.0 Tasks 14

6.0 The Communication Strategy 15

6.1 Congressional Coordination 15

6.2 Interagency Coordination 15

6.3 EPA Citizen Advisory Committee Coordination 15

6.4 Long Range Water Supply Process Action Team Coordination 16

6.5 Community Working Group Coordination 16

6.6 News Media 16

6.7 Open Houses 16

6.8 Public Meetings 17

6.9 Information Repositories 17

6.10 Mailing List 17

6.11 IRP Coordination 17

6.12 Informational Materials 18

6.13 World Wide Web Page 18

6.14 Display Advertisements 18

7.0 Public Involvement Specifics 19

7.1 Near Term Public Involvement Activities 19

7.2 Ongoing Public Involvement Activities 20

1.0 Introduction

This Public Involvement Plan has been developed for the National Guard Bureau (NGB) and the Massachusetts Army National Guard (MAARNG) to establish a comprehensive communication model for the public involvement activities at the Massachusetts Military Reservation (MMR). This plan includes public communication and involvement activities for the following environmental programs at MMR: the Impact Area Groundwater Study, the Range Maintenance Project, and the Environmental Impact Statement/Report (EIS/EIR). The contents of this plan are in compliance with the Environmental Protection Agency (EPA) Administrative Order, dated February 27, 1997.

This plan will: (1) detail the strategy for communicating progress to the regulators (EPA and the Massachusetts Department of Environmental Protection [MA DEP]), the designated EPA Citizens Advisory Committee, the EIS/EIR Community Working Group, the Installation Restoration Program (IRP) Long Range Water Supply Process Action Team (LRWS PAT), and the general public, and (2) provide information on public involvement opportunities. All of the activities recommended throughout this plan will be coordinated with NGB and the MAARNG.

It is expected that with the execution of this plan, communications during the conduct of the MMR public involvement activities will be comprehensive and understandable. This strategy is meant to promote two-way dialogue among the NGB, the MAARNG, and all interested parties. Above all, this communication model will ensure that public officials and citizens have access to the Impact Area Groundwater Study, EIS/EIR, and Range Maintenance Project progress and informational materials. This plan defines a framework for meaningful public dialogue during each of these MMR activities.

The plan:

- Establishes a process to maximize public involvement during the conduct of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project;
- Identifies specific procedures for managing public and news media communication throughout these processes; and
- Enhances cooperation and coordination with the regulators, the designated EPA Citizens Advisory Committee, the EIS/EIR Community Working Group, the LRWS PAT, and the general public.

It is the policy of the NGB and the MAARNG to keep the public fully informed and involved with proposed actions that have the potential to affect the environment, safety, and public health.

2.0 Purpose and Objectives

This Public Involvement Plan was developed to ensure that the NGB and MAARNG fully demonstrate to public officials, special interest groups, and the concerned public that the National Guard is a reliable partner in environmental matters. Therefore, the NGB and MAARNG have determined that the efforts involved with the development and execution of this plan will maximize the flow of public information and more fully involve interested parties in the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project.

The NGB and the MAARNG have determined the following.

- Public affairs is essential to the design, management, and execution of the public involvement program before, during, and after each of these MMR activities.

- Public affairs must integrate the latest communication technologies with the media relations, public information, community relations, command information, legislative liaison, interagency coordination, and project management elements of the MMR Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project.

- The NGB Public Affairs Office, Environmental Programs (NGB-PAI-E), and the MMR Environmental Impact Statement Public Affairs Office will have joint responsibility for the execution of this communication strategy.

- The NGB Public Affairs Point of Contact is Dan Allen, (703) 681-0707 or (800) 252-8959. The MMR Public Affairs Point of Contact is Don Consolmagno, (508) 968-5824.

The communication strategy emphasized throughout this plan will assist the NGB and the MAARNG to facilitate a full and fair discussion of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. It will enable National Guard officials to involve the public as a partner in the decision-making process. Furthermore, this strategy complies with the EPA Administrative Order, dated February 27, 1997.

The primary objective for this communication strategy is to define the public affairs activities for the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. This strategy focuses upon specific activities to be implemented during these activities. Sections 6.0 and 7.0 of this plan detail the public affairs activities that will be undertaken during the Impact Area Groundwater Study, the EIS/EIR (including the Supplemental Draft EIS/EIR), and the Range Maintenance Project.

3.0 Ongoing Studies, Projects, and Issues

MMR is an approximately 22,000-acre facility located in western Cape Cod in the towns of Bourne, Falmouth, Mashpee, and Sandwich in Barnstable County. Military use of MMR dates back to 1911. The most intensive use of the facility occurred during and immediately after World War II. Since 1911, the small arms ranges, the demolition ranges, and the impact area have been used for military and law enforcement training.

3.1 Description of the Impact Area Groundwater Study

The NGB is conducting an environmental study of the groundwater beneath the impact area, small arms ranges, and demolition ranges at the MMR. The goal of the Impact Area Groundwater Study is to determine the effects of military operations on the groundwater beneath the impact area.

The Impact Area Groundwater Study began with the commitment from Sherri Goodman, Deputy Undersecretary of Defense for Environmental Security in July 1996. Since that time, the EPA, the MA DEP, and the LRWS PAT, a community advisory group for the MMR IRP, have been asked to assist in the development and review of the study plan, analysis, and results.

3.1.1 Focus

The soil and groundwater in the study area (the impact area, training ranges, and two demolition ranges) will be analyzed for military operations-related constituents.

The study area covers 14,000 acres in the central portion of MMR. Numerous firing ranges, gun and mortar positions, and two demolition ranges surround the impact area. When artillery pieces or small arms are fired, the spent munitions enter the soils in these locations. A search of historic records at MMR suggests that 75 percent of the munitions used today, and in the past, consisted of heavy metals. Twenty-five percent of the munitions consisted of explosives. Over an extended period of time, heavy metals and explosives may have built-up in the soils.

Therefore, the study will focus on any munitions-related metals and explosives, and their by-products, that may be found in the soil and groundwater in the study area, although a percentage of the samples will be analyzed for additional components. The Administrative Order requires study of surface water and storm water, in addition to groundwater and soil.

3.1.2 Approach

The study is being conducted using a flexible approach. Initial sampling results will be used to focus further study. If results indicate a need for further study of any one location, that investigation will proceed immediately.

The initial part of the study will begin with the installation of monitoring wells within the impact area. Selected IRP monitoring wells will supplement these wells. The monitoring well network will also include the potable water source investigation test wells installed by Stone and Webster in 1996 under contract to the Air Force Center for Environmental Excellence.

During the study, personnel will also review aerial photographs to locate potential sampling sites; survey the areas for unexploded ordnance; and sample the surface water, soil, sediments, and storm water as the monitoring wells are being installed. Soil samples from potential source areas inside the impact area will also be taken and analyzed.

Sample analysis will focus on compounds relating to explosives and heavy metals. A percentage of samples from each sampling area will be analyzed for all contaminants. A selected number of samples will also be analyzed for other compounds, not related to explosives or metals.

A Preliminary Risk Evaluation will be conducted to determine if the compounds found are at concentrations that may affect humans and plant and animal life.

If compounds are found that have impacted the groundwater, additional wells may be installed. These wells will be installed to locate the source of the compounds.

3.1.3 Public Participation

The Groundwater Study involves regulators and the public. The EPA, the MA DEP, and the LRWS PAT have played, and will continue to play, an important role in the planning and implementation of this study. Furthermore, study plans and results will be shared with the designated EPA Citizens Advisory Committee. The general public will begin their opportunity for participation with the distribution of the Draft Action Plan for the Impact Area Groundwater Study.

Public involvement opportunities will include:

- Progress updates at the IRP Senior Management Board meetings.
- Informational open houses.
- Comment periods.
- Progress updates published in the print media.
- Status updates from the LRWS PAT.
- Current updates on the World Wide Web page (http://www.tiac.net/users/mmreis).

- Direct mailing of informational materials to *focus* newsletter mailing list.

- Points of contact for the public through the mail or by telephone (Unified Environmental Planning Office, Building 1204, Camp Edwards, Massachusetts 02542; 508-968-5824 or 5908.)

3.1.4 Schedule

The NGB, as manager of the study, distributed the Draft Action Plan to the EPA, the MA DEP, and the MMR IRP LRWS PAT in December 1996. After review by these groups, comments were incorporated.

The revised Draft Action Plan is scheduled for release in the public libraries of the four towns surrounding MMR and in the library at the U.S. Coast Guard Air Station - Cape Cod on March 14, 1997. The public is invited to review and comment on the plan. A news release, announcing the availability of the plan, will be distributed to all area news outlets. An Open House, sponsored by EPA, will be held on March 20, 1997, to formally gather comments on the Draft Action Plan.

Following the two week public comment period, the Action Plan will be finalized.

The anticipated schedule for conducting the study is described below. If activities occur that result in a delay in the study and distribution of results, the regulators and public will be informed.

- The initial contracting work to retain the technical firm to conduct the study was begun on March 1, 1997. The contractor will be "on-board" within 45 days of the date of the Administrative Order.

- The Action Plan will be implemented by mid-April 1997.

- The fieldwork is expected to take approximately 4 months.

- A Preliminary Risk Evaluation will be conducted as data becomes available.

- The initial report on the results and findings will be available no later than 45 days after the completion of fieldwork.

- Human Health Risk Assessments will be conducted after all initial fieldwork is completed.

3.2 Description of the MMR EIS/EIR

In compliance with the National Environmental Policy Act, the Massachusetts Environmental Policy Act, and the Consent Decree, the NGB and the Massachusetts Military Division (MMD) is developing an EIS/EIR. The EIS/EIR addresses the environmental impacts related to the proposed facilities upgrade for the Massachusetts National Guard. The Massachusetts Military Division (MMD) in conjunction with the NGB has proposed 10 projects to support the mission of the MAARNG and the Massachusetts Air National Guard (MAANG). These 10 actions can be divided into two categories: Range Projects and Cantonment Projects.

Five range projects are being proposed:

1. Modified Record Fire Range: used to train and qualify soldiers on the M16 rifle.

2. Multi-Purpose Machine Gun Transition Range: used to train and qualify soldiers on various machine guns and the sniper rifle.

3. Infantry Squad Battle Course: used to train infantry soldiers on how to conduct small group tactical movements and attack enemy positions.

4. Military Operations on Urbanized Terrain-Military Assault Course: used to train individuals or small groups on techniques used in urban combat situations.

5. Military Operations on Urbanized Terrain-Collective Training Facility: the continuation of Military Operations on Urbanized Terrain training used to train small or large group techniques used in urban combat situations.

Five cantonment projects are being proposed:

6. Unit Training Equipment Site: a facility used to store and maintain vehicles and equipment assigned to Camp Edwards.

7. Airfield Control Tower: a facility that houses air traffic control personnel and equipment.

8. Aircraft Generation Unit Facility: an aircraft hangar used to conduct minor pre-flight maintenance activities on aircraft assigned to Otis Air National Guard Base.

9. Fire Station: a facility that houses fire protection personnel and equipment.

10. Environmental Facility: an administrative facility that houses Otis Air National Guard Base environmental personnel.

3.2.1 Purpose and Need

The purpose of the proposed facilities upgrade is to provide the necessary training and facilities to maintain the readiness of the Massachusetts National Guard to stay current with changing military training and doctrine. Military units must maintain a high level of training and state of readiness to support national defense and state missions in times of natural disaster, civil unrest, and other emergencies. Reductions in the nation's active military forces during the past decade have placed an even greater emphasis on the mission of the Reserve and Guard forces. Adequate training opportunities must be available for military units to achieve their mandated readiness goals, which can only be attained with modern equipment, training, and support facilities.

3.2.2 Public Participation

In addition to soliciting public and agency comment all EIS/EIR documents, the NGB, Massachusetts National Guard, and the MA DEP's Executive Office of Environmental Affairs (EOEA) has implemented other steps to keep the regulators and public informed regarding the proposed projects. These steps were taken both prior to and during the preparation of the Draft EIS/EIR. The steps will continue to be implemented throughout the entire EIS/EIR process.

The following public participation methods are, or have been, implemented.

- A Notice of Intent was published in the Federal Register in August 1994 to announce the NGB and Massachusetts National Guard's intention to begin an Environmental Impact Statement for the 10 proposed projects.

- A Public Scoping Meeting was held at the Morse Pond School in Falmouth on November 2, 1994, to identify potential alternatives and public concerns associated with the 10 proposed projects. This meeting included information booths staffed with MAARNG and MAANG personnel to answer questions and provide technical background on the 10 projects, and a discussion panel consisting of representatives from EOEA, NGB, MAARNG, and MAANG.

- The public comment period for the Draft EIS/EIR began on December 3, 1996 and has been extended to end on April 9, 1997.

- Public information sessions (open houses) were held in Bourne, Falmouth, Mashpee, and Sandwich and at the MMR following the release of the Draft EIS/EIR and before the public meeting in Falmouth.

- A public meeting was held in Falmouth on January 15, 1997, to accept comments on the Draft EIS/EIR.

- Quarterly newsletters to update the public on the status of the Draft EIS/EIR and other associated issues are mailed to approximately 1,300 people.

- MAARNG has established a web page (http://www.tiac.net/users/mmreis) that provides information on the proposed projects and the EIS/EIR.

- The Unified Environmental Planning Office at MMR provides an additional on-site resource available to the public for information regarding the status of the EIS/EIR.

- A Community Working Group is being formed by EOEA to assist in the review of the Draft EIS/EIR and the upcoming Supplemental Draft EIS/EIR.

3.2.3 Supplemental Draft EIS/EIR

In February 1997, the NGB and the Massachusetts National Guard announced that a Supplemental Draft EIS/EIR will be issued after receiving the data from initial investigations of the Impact Area Groundwater Study. This supplemental document will be released for public review and comment following the same communications strategy (comment period, open houses, and public meeting) used for the Draft EIS/EIR.

The Supplemental Draft EIS/EIR will include the information contained in the Draft EIS/EIR, plus data from the Impact Area Groundwater Study. The Community Working Group will be asked to assist the NGB and the Massachusetts National Guard in reviewing the data in the Draft and Supplemental EIS/EIR.

3.3 Description of the Range Maintenance Project

On March 3, 1997, Lieutenant General Edward D. Baca, Chief of the National Guard Bureau, and Major General Raymond A. Vezina, Adjutant General for the State of Massachusetts, announced that a Range Maintenance Project will begin immediately. This project will address regulatory and public concerns about range training operations at MMR.

3.3.1 MMR Actions

The immediate actions to be taken by the NGB and the MAARNG are:

- Procurement and installation of impermeable flexible membrane liners to cover the berms and backstops of all existing small arms ranges at MMR. This cover will eliminate water transport of lead through the soil.

- Suspension of firing of lead munitions on 9 small arms ranges on MMR.

- Action to determine the best technology to remove lead and other metals from the berms and backstops of all existing small arms ranges.

Future actions will include:

- Changing the type of projectiles being used to train crews of indirect fire weapons (mortars) from those that explode on impact (high explosives) to an environmentally-friendly round, such as the Low-cost Indirect Training Round (LITR) which does not explode on impact. The MAARNG is currently using the LITR when firing the 155-millimeter Howitzer artillery piece. The LITR contains a smoke charge for spotting, but no explosives.

- Seek funding to refurbish all active ranges to include new technologies such as munitions-absorbing concrete, called sacon, and bullet traps. New range designs will consolidate spent munitions that can be reprocessed. Further availability of "environmentally-safe" munitions will be sought.

- Incorporate use of more simulation capabilities for training.

3.3.2 Public Participation

The NGB and the MAARNG will continue to work with the EPA, the MA DEP, and the public to ensure that these measures will go forward to allay public concerns and protect the health and safety of the military personnel on the base and the surrounding community neighbors. The regulators will be kept abreast of progress through update meetings and progress reports. The public will be updated on progress through existing IRP Senior Management Board meetings, informational open houses, progress updates, the quarterly newsletter, and the MMR World Wide Web page.

3.4 Description of the EPA Administrative Order

The EPA, Region I, issued an Administrative Order on February 27, 1997, in response to concerns about the impacts of range training operations on the groundwater under, near, and emanating from the MMR Camp Edwards Impact Area and Training Ranges. This Order was issued through the authority of Section 1431 of the Safe Drinking Water Act.

3.4.1 Scope of Work

The Scope of Work, attached to the Administrative Order, defines the response actions and obligations that the National Guard must perform to implement the work required under the Administrative Order. By March 14, 1997, the NGB must provide to EPA and the public any and all information in its possession on known or potential contaminants in the soil and groundwater on, near, and emanating from the Training Range and Impact Area. The NGB must also make available to EPA and the public an accelerated schedule and work plan with specific dates for conducting and completing an independent, comprehensive study of the effects on public health and the environment of past, present, and future activities on or near the Training Range and Impact Area. The work plan must be initiated within 15 days of EPA's approval of the schedule and the plan.

3.4.2 Public Involvement

The Administrative Order requires that the NGB ensures adequate public involvement in all the work undertaken in the Order. The public involvement plan must include:

- Procedures for immediately providing the public with all nonprivileged information obtained or compiled under the Order.

  ⇒ *The NGB and MAARNG will establish Information Repositories in the public libraries of the four surrounding towns (Bourne, Falmouth, Mashpee, and Sandwich) and the U.S. Coast Guard - Air Station Cape Cod library at MMR. Copies of all public documentation will also be available for public review at the Unified Environmental Planning Office at MMR. The locations of these Information Repositories will be announced in display advertisements and news releases.*

- Coordinating the work under the Order and Scope of Work with a Community Advisory Committee which may be formed by EPA Region 1. The NGB will provide resources for the effective functioning of this group.

  ⇒ *If this group is formed, the NGB and the MAARNG will hold periodic meetings to provide status updates to the public for comment on the activities at MMR. It is expected that the meetings will be held monthly. However, if necessary, the frequency of these meetings will be increased. Meeting space will be available at the Massachusetts Military Reservation. The NGB and MAARNG will ensure that all applicable reports, plans, and results are available to the Committee for their review.*

- Providing periodic oral and written updates to the public on the progress of the work.

  ⇒ *The NGB and MAARNG will update the public through news releases, the focus newsletter, fact sheets, progress updates published as newspaper display advertisements, the MMR World Wide Web page, open houses, mail outs, and meetings with various community groups, including Upper Cape Cod service organizations, the IRP Senior Management Board, and other IRP forums as appropriate.*

- Immediately sharing with the public all conclusions reached by the NGB.

  ⇒ *The NGB and MAARNG will share all study results and conclusions in a timely manner with the public through news releases, the focus newsletter, fact sheets, progress updates published as newspaper display advertisements, the MMR World Wide Web page, open houses, mail outs, and meetings with various community groups, including Upper Cape Cod service organizations, the IRP Senior Management Board, and other IRP forums as appropriate.*

- Coordinating the work under the Order and Scope of Work with the response actions being undertaken by the MMR IRP.

  ⇒ *The NGB and MAARNG will work with the Public Affairs Office of the IRP to ensure that Impact Area Groundwater Study, EIS/EIR, and Range Maintenance Project information is available for the IRP Process Action Team meetings, as appropriate, and the IRP Senior Management Board meetings. The NGB and MAARNG will update members of the Senior Management Board. The NGB and MAARNG will continue to work with the LRWS PAT during the conduct of the Impact Area Groundwater Study. Links to the MMR IRP Home Page on the World Wide Web will be established on the MMR World Wide Web page (http://www.tiac.net/users/mmreis).*

4.0 Principles of Public Dialogue

One of the most important considerations during the conduct of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project is for the NGB and the MAARNG to encourage public input throughout these activities. This is also a principal tenet of the Administrative Order.

Throughout these activities, the NGB and the MAARNG will:

- Present a clear and concise explanation of the work being performed.
- Assure the public of a full and fair discussion of the issues.
- Encourage public involvement.
- Respond to requests for information or public documents.
- Facilitate public comment.
- Follow up.

4.1 Cardinal Rules of Risk Communication

The following principles for communicating with the public about environmental concerns have been published by the U.S. Environmental Protection Agency. They are founded largely on university-based research conducted by Dr. Vincent Covello, Director, Center for Risk Communication at Columbia University, New York City.

There are no easy prescriptions for successful risk communication. However, those who have studied and participated in recent debates about risk generally agree on several cardinal rules. These rules apply equally well to the public and private sectors.

1. **Accept and involve the public as a legitimate partner**
   A basic tenet of risk communication in a democracy is that people and communities have a right to participate in decisions that affect their lives, their property, and the things they value.

2. **Plan carefully and evaluate your efforts**
   Communication will be successful only if planned with your receiving public in mind. Carefully evaluate your efforts and learn from the feedback you have received.

3. **Listen to the public's specific concerns**
If you do not listen to people, you cannot expect them to listen to you. Communication is a two-way activity.

4. **Be honest, frank, and open**
In communicating risk information, trust and credibility are your most precious assets. Provide requested information as soon as possible. Share more, not less.

5. **Meet the needs of the media**
The media is a prime transmitter of information on risks; it plays a critical role in setting agendas and in determining outcomes.

6. **Speak clearly and in terms that are understandable**
Technical language and jargon are useful as professional shorthand, but they are barriers to successful communication with the public.

5.0 Tasks

The NGB Installation Logistics and Environment Division (ILE-E) is responsible for consultation and coordination with the Department of Defense, the EPA, the MA DEP, and other internal or external federal, regional, state, and local agencies or organizations. As manager of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project, NGB-ILE-E will:

- Produce and evaluate technical analytical data.
- Consolidate public comments.
- Respond to public comments.
- Perform document reviews.
- Ensure that results are effectively addressed in public documents.

NGB Public Affairs, Internal Programs, Environment (PAI-E) and the MMR Environmental Impact Statement Public Affairs Office have the primary responsibility for implementing this Public Involvement Plan. The Public Affairs Offices will coordinate on all public and congressional responses. These offices will:

- Maintain and update the Public Involvement Plan.
- Produce display advertisements/legal notices.
- Develop fact sheets, brochures, or newsletters, as determined.
- Prepare displays for public meetings.
- Schedule press briefings.
- Develop news releases.
- Produce audio-visual products, as required.
- Maintain a current mailing list.
- Establish logistical procedures for public meetings.

The NGB has identified the following mailing address for receipt of public comment:

Unified Environmental Planning Office
Building 1204
Camp Edwards, Massachusetts 02542-5003

6.0 The Communication Strategy

The success of this communication strategy is contained in the most basic public affairs principle: "maximum information with minimum delay." This premise has been incorporated throughout this plan to ensure numerous opportunities for public involvement throughout the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. These numerous opportunities are also in compliance with the EPA Administrative Order.

This plan builds upon the NGB's efforts toward meaningful public dialogue about environmental matters. It acknowledges a likely perception by some that the government is uninterested in public concerns and is generally unwilling to take actions which give consideration to those concerns.

The Public Affairs Offices have determined that the following elements, as a minimum, will be embodied in the public affairs program to ensure timely public notification about the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. These elements will also maximize public information and public involvement before reaching final decisions.

6.1 Congressional Coordination

It is expected that the members of the Massachusetts congressional delegation will take an active interest in the Impact Area Groundwater Study and the Range Maintenance Project. These elected officials have already expressed interest, and will continue to express interest, in the EIS/EIR. Therefore, the NGB has offered, and will continue to offer, these members or their staffs opportunities for briefings and periodic updates throughout the process.

6.2 Interagency Coordination

During the Impact Area Groundwater Study, the NGB will consult with representatives from the Department of the Army , Department of the Air Force, and other federal agencies. The purpose of this consultation is to solicit input into the study. The NGB is also coordinating with the Department of the Army on the Range Maintenance Project. Continual coordination on all issues with the EPA and the MA DEP will be maintained.

6.3 EPA Citizen Advisory Committee Coordination

During the Impact Area Groundwater Study and the Range Maintenance Project, the NGB will coordinate the work being conducted with the designated EPA Citizen Advisory Committee. The NGB will provide resources for the effective functioning of this committee and ensure that all plans and reports are provided for their review. Once this group is formed, the NGB and the MAARNG will hold periodic meetings to provide status updates on the activities at MMR. It is expected that the meetings will be held monthly. However, if necessary, the frequency of these meetings will be increased. Meeting space will be available at the Massachusetts Military

Reservation. The NGB and MAARNG will ensure that all applicable reports, plans, and results are available to the Committee for their review.

6.4 Long Range Water Supply Process Action Team Coordination

During the Impact Area Groundwater Study, the NGB will consult with LRWS PAT. The purpose of this consultation is to solicit input into the study action plan and review the study results.

6.5 Community Working Group Coordination

During the EIS/EIR, the NGB will consult with the EOEA-sponsored Community Working Group. The purpose of this consultation is to solicit input into the Draft EIS/EIR and the Supplemental Draft EIS/EIR.

6.6 News Media

The Public Affairs Offices will ensure that press releases and information materials are distributed throughout the duration of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project to the news media. When applicable, photographs will be distributed with these press releases. Responses to media queries will be expedited through coordination, as appropriate, with NGB-ILE-E subject matter experts. A listing of subject matter experts will be developed by NGB-PAI-E to aid the process of expediting internal coordination on proposed news releases and responses to media query. Responses to media and public inquiries will be available as soon as possible, with a goal of no longer than 24 hours.

During the Impact Area Groundwater Study fieldwork, daily press briefings will be held to update the media on the status of the well drilling and sampling program.

6.7 Open Houses

The Public Affairs Offices plan will hold open houses pertaining to the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. These will be scheduled for federal and state government agency representatives, special interest groups, service organizations, and affected local citizens throughout the study.

6.8 Public Meetings

Public meetings will continue to be held throughout the upcoming Supplemental Draft EIS/EIR public comment period. These meetings will be held in accordance with the National Environmental Policy Act and the EPA Administrative Order.

6.9 Information Repositories

Information Repositories will be established to contain all relevant studies, plans, and findings for the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. The repositories will be co-located with the available public information regarding the IRP. These repositories will be maintained in the public libraries in Bourne, Falmouth, Mashpee, and Sandwich, and the U.S. Coast Guard Air Station Cape Cod library on the Massachusetts Military Reservation. Relevant studies, plans, and findings for the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project will also be available for public review in the Unified Environmental Planning Office on the Massachusetts Military Reservation. The public can also review IRP information at the IRP offices on MMR.

6.10 Mailing List

A mailing list has been developed for use in informing the regulators and the public about the progress of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. The mailing list includes all names and organizations currently receiving the *focus* newsletter. Other persons or organizations wishing to be included on the mailing list should notify Don Consolmagno, Unified Environmental Planning Office, Building 1204, Camp Edwards, Massachusetts 02542-5003; telephone: 508-968-5824.

6.11 IRP Coordination

The NGB and the MAARNG will continue to attend the IRP Senior Management Board meetings to update the public on the progress of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project. The Executive Director of the Special Military Reservation Commission co-chairs the Senior Management Board.

The NGB and MAARNG will also continue working with the LRWS PAT on the Impact Area Groundwater Study. This partnership will continue the IRP coordination efforts. The purpose of this consultation is to solicit input into the study action plan and review of the study results.

Links to the MMR IRP Home Page on the World Wide Web will be established on the MMR World Wide Web page (http://www.tiac.net/users/mmreis).

6.12 Informational Materials

Fact sheets, progress updates, and newsletters will be developed for distribution to the public. Fact sheets will be available at all informational workshops (open houses), public meetings, in the information repositories, and at the Unified Environmental Planning Office. Progress updates will be published in the print media as a display advertisement and mailed to elected officials outside of the Upper Cape Cod area. Progress updates will also be available at the open houses, public meetings, in the information repositories, and at the Unified Environmental Planning Office. The newsletter will be distributed to the addressees on the mailing list.

6.13 World Wide Web Page

The MMR World Wide Web Page (http://www.tiac.net/users/mmreis) will continue to be updated. This Web page will include the information on the current status of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project, names and addresses of National Guard contacts, and articles about various areas of the activities.

Links to the MMR IRP, the EPA, Region 1, and the MA DEP Home Pages on the World Wide Web will be established on the MMR World Wide Web page.

6.14 Display Advertisements

Display advertisements will be developed and placed in Upper Cape Cod newspapers to announce major events, such as open houses and public meetings, along with the availability of plans and reports.

7.0 Public Involvement Specifics

This Public Involvement Plan is currently being implemented. Some specific activities which have taken place or are planned to ensure full communication and public involvement in NGB and MAARNG activities are listed below.

7.1 Near Term Public Involvement Activities

Near-term public communication efforts include:

- A presentation about explosives and their constituents to educate members of the Long Range Water Supply Process Action Team. (February 1997)
- Meetings with EPA, MA DEP, and LRWS PAT to discuss comments on the Impact Area Groundwater Study Draft Action Plan. (March 1997)
- Establishing Information Repositories in the local public libraries and at the Unified Environmental Planning Office. (March 1997)
- Development of a responsiveness summary, included as an appendix to the Impact Area Groundwater Study Draft Action Plan, detailing the disposition of all comments on the plan. (March 1997)
- Development of an Executive Summary and a Groundwater Terminology Glossary for the public release of the Impact Area Groundwater Study Draft Action Plan. (March 1997)
- Display advertisements in area newspapers announcing the public availability of the Impact Area Groundwater Study Draft Action Plan in the local libraries and the Unified Environmental Planning Office. (March 1997)
- A comment period for the public to review and comment on the Impact Area Groundwater Study Draft Action Plan. (March 14 - March 31, 1997)
- An open house and update of the Impact Area Groundwater Study progress at the monthly Senior Management Board meeting. (March 18, 1997)
- An EPA-sponsored public meeting during the Impact Area Groundwater Study Draft Action Plan comment period to receive comments from the public on the plan. (March 20, 1997)

7.2 Ongoing Public Involvement Activities

Ongoing public communication efforts for the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project include:

- Periodic meetings with the designated EPA Citizens Advisory Committee.
- Continual meetings with regulators and the LRWS PAT.
- Periodic meetings with the EIS/EIR Community Working Group.
- Display advertisements in area newspapers announcing the public availability of the plans and study results in the local libraries and the Unified Environmental Planning Office.
- Public comment periods upon the release of documents.
- Public open houses at intervals throughout the activities.
- Exhibits for use during open houses.
- Fact sheets regarding various aspects of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project.
- Progress updates throughout the life of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project.
- Articles for the *focus* newsletter describing the progress Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project.
- Elected officials (federal, state, and local) updates on the progress of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project.
- Updates of the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project progress at IRP Senior Management Board meetings.
- Weekly updates to the MMR Web page - http://www.tiac.net/users/mmreis.
- Availability of a Speakers Bureau to inform community organizations about the Impact Area Groundwater Study, the EIS/EIR, and the Range Maintenance Project.
- Consideration for holding periodic Senior Executive In Progress Review Briefings for the purpose of status updates and problem resolution. Desired participation in these briefings would be NGB, MAARNG, EPA, and MA DEP.